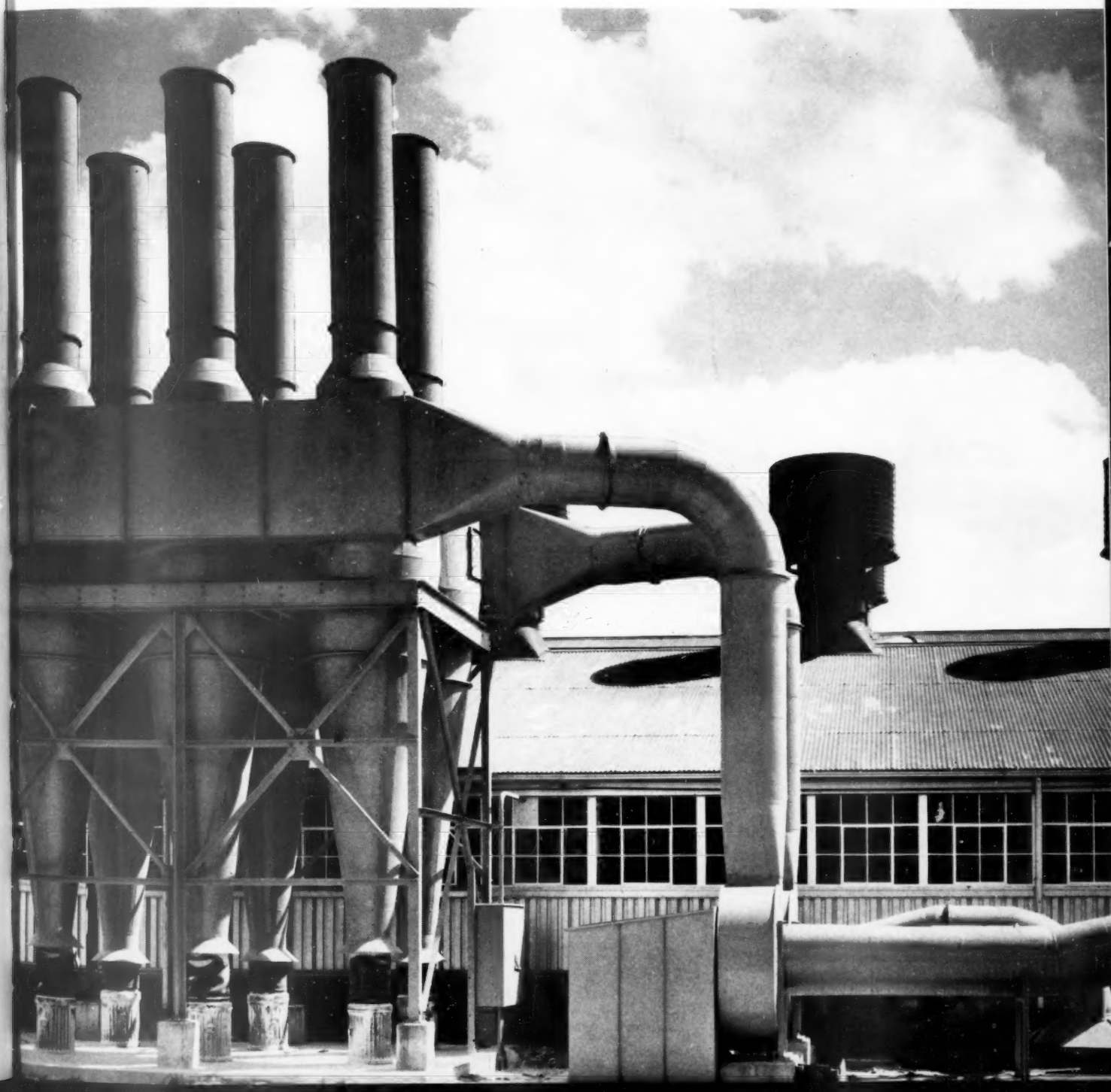
AIR ENGINEERING

SEPTEMBER, 1961

VOL. 3, NO. 9

AIR QUALITY CONTROL . . . FOR COMFORT, PROCESS AND PROFIT

- Industrial Heat Exposure And Control p. 21
- Do It Yourself . . . How To Design Make-Up Air Systems p. 24
- Air Conditioning A Technological Complex p. 28
- **Air Systems In The Glass Industry p. 33**



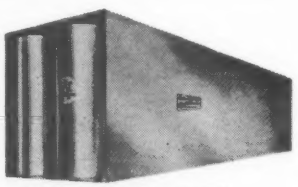
Fan Noise CONTROLLED in Air Handling Systems QUICKLY & ACCURATELY in less than 5 minutes!

Recognition that noise generated by fans in air handling systems could be predicted and controlled has led to a series of developments in both the "calculations" and also the necessary noise control equipment.

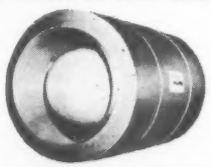
Guesstimating has now been eliminated by the general acceptance of these 4 important steps, functions and/or considerations: (1) that the total fan noise and its spectrum is substantially per the ASHRAE GUIDE dated 1957 or later (2) that we now have workable data covering the natural noise reduction due to ductwork, elbows, splits, distances, end reflections, room absorptions, etc. (3) that we have NC and NCA criteria for each of the 8 octave bands for most types of areas and we can now specify what is desired, and more important, by using an octave band analyzer, it can be readily determined whether the specified criteria has or has not been met (4) the development of prefabricated noise reduction units (noise traps, sound traps, etc) which have been properly factory tested and rated so they can be used with the method mentioned above.

"Short Form" Makes Selection Easy

Since that time, because of the progress made in the design of Quiet-DUCT Silencers, and the wide acceptance of newly developed techniques mentioned above, the "Short Form" has been developed to make the selection of unit silencers for air handling systems an easy matter.

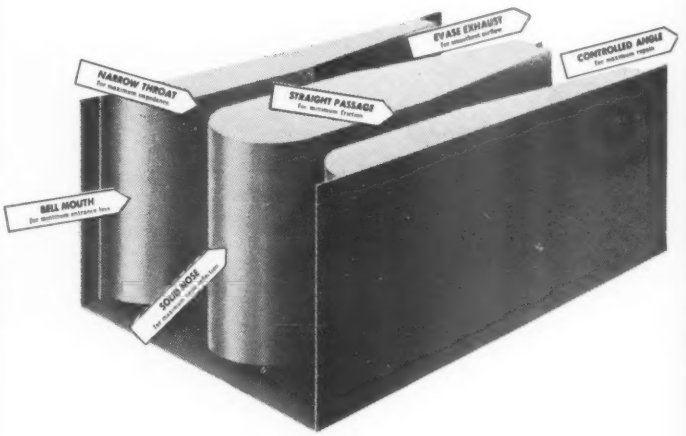


QUIET-DUCT SILENCERS
4 STANDARD MODELS
4 LOW PRESSURE MODELS
44 UNIT SIZES
90 MULTIPLE UNIT SIZES



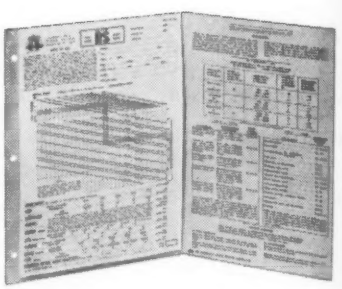
CONIC-FLOW SILENCERS
18 STANDARD UNIT SIZES

"Cut-Away" View Reveals New Design of "Packaged" Quiet-DUCT Silencers.



Over ten years of experience in controlling noise in air handling systems has resulted in this new, basic design for all "packaged" silencers manufactured by our company. Design requirements include: *Bell Mouth Entrance* for minimum air pressure loss; *Solid Nose* for maximum noise reflection; *Narrow Throat* for maximum noise impedance. *Straight Passages* provide smoother airflow with more silencing and less regenerated noise. *Less Pressure Drop* is achieved by the diverging design of the evasè exhaust, keeping turbulence at a minimum and attaining maximum pressure regain.

The "SHORT FORM" consists of a small binder containing a pad of 25 reproducible work sheets. Only one such sheet is necessary to quickly and accurately resolve each noise problem and determine whether silencers are required, and if so, the silencer model needed to provide the Noise Reduction required for the problem. The "SHORT FORM" gives the Noise Reduction required in the 3rd octave band (in decibels) based on the data and procedures published in the ASHRAE GUIDE & DATA BOOK. Many field experiences have demonstrated that 3rd band calculations, by themselves, are a reliable index to silencing requirements as related to air handling systems. Because of the inherent characteristics of the "packaged" Quiet-DUCT silencers — if silencing is required in the 3rd Band, and the unit silencer is selected based on this criteria, more than enough noise reduction will be provided for all other bands as well.
The "SHORT FORM" is available through our representatives or write direct.



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[For more information circle #11 on page 37 reply cards]

AIR ENGINEERING

VOL. 3, NO. 9

SEPTEMBER, 1961

AIR QUALITY CONTROL . . . FOR COMFORT, PROCESS, PROFIT

FEATURES

Industrial Heat And Its Control Part III 21

by Robert Lemke, mechanical engineer. Part three of series discusses mechanical means of cooling plant personnel.

How To Design Make-Up Air Systems 24

by George W. Reznor, vice president, engineering, Reznor Mfg. Co. How to design your own make-up air system, with details on controls, data on equipment sizing and its selection, tips on problems.

Air Conditioning A Technological Complex 28

by R. S. Sloan, facilities director, Texas Instruments, Inc., and J. B. Meek, Air Conditioning & Engineering Associates, Inc., Detroit, Mich. and Dallas, Texas. Toxic fume removal, accurate temperature control, handling concentrated high equipment gains, are problems discussed in this article about new semi-conductor facility.

Air Systems In The Glass Industry 33

by W. T. Fleming, Kirk & Blum Mfg. Co. By the use of proper design of furnace cooling systems, combustion air distribution, and dust collection, product production is boosted and life of manufacturing equipment is lengthened.

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New Products	39

Advertisers Index.....Inside Back Cover

COVER

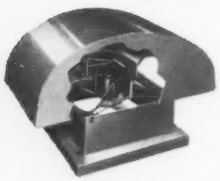
Photo shows six Kirk & Blum Type C, Design 4, Hi-Efficiency centrifugal collectors for cullet dust control. Buffalo Forge Co., Type MW Fans.

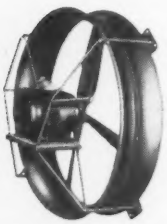
See Air Systems In The Glass Industry, page 33.

AIR ENGINEERING is published monthly by Business News Publishing Company, at 450 West Fort Street, Detroit 26, Michigan. Subscription prices: United States, Canada: $3.00—1 year; $4.50—2 years; $6.00—3 years. Foreign: $5.00—1 year; $8.50—2 years; $12.00—3 years. Single copies 50 cents. Second-class postage paid at Detroit, Michigan. First issue April, 1959. • CHANGE OF ADDRESS. Notify AIR ENGINEERING and your local Post Office of both your old and new addresses including postal zone numbers by 12th of preceding month. • CONTENTS COPYRIGHT 1961 by Business News Publishing Company. Reproduction of material may not be made without written permission of the publisher.

HERE'S NEWS

about fans that move air in
either direction with equal efficiency...
HARTZELL REVERSIBLE FANS





Intake one minute, exhaust the next, with the same fan. You can do it with the unique Hartzell reversible fan — making one unit do the work of two with air moving efficiency that is seldom achieved with a conventional one-way fan. Hartzell reversible fans are ideal for many special ventilating jobs and for a wide variety of cooling and drying applications. Sizes from 18" to 42", in ring or duct section mounting or in a special roof ventilator housing. Here's more proof that Hartzell has the equipment, and the engineering "know-how", to help you solve your unusual air moving problems.

For complete details, just give your nearby Hartzell field engineer a call. You'll find him listed in the Yellow Pages or in the Hartzell catalog in Sweet's Plant Engineering and Industrial Construction Files.

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[For more information circle #14 on page 37 reply cards]

Letters

Special Interest In March Issue Articles

Editor:

Two articles in the March issue of AIR ENGINEERING have special interest to me. First is the article on the Convair Division entitled "Plant-wide Air Conditioning Costs Only .0471¢ Per Man Hour."

The second one is the full factory air conditioning at Sylvania.

Would it be possible to secure 50 each reprints of these articles?

Your publication is doing good work in carrying such factual, helpful information.

F. C. Brandt
Commercial Sales Manager
Minneapolis-Honeywell
Regulator Co.
International Division
Minneapolis, Minn.

Doesn't Want To Miss An Issue

Editor:

Please be advised that we have moved into our new facility at 1246 Birchwood Dr., Sunnyvale, California. We certainly do not wish to miss our next copy of your fine magazine on subjects so close to our interests.

A portion of this new plant will be specifically dedicated to ultra-clean environmental conditions so that we may deliver a sterile product to our customers. We will inform you of our design criteria and level of accomplishment which may be of reader interest.

Thanking you in advance for a prompt change of your mailing records.

R. L. Briggs, Jr.
President
Sonic-Air Products, Inc.
Sunnyvale, California

Use the Communications Center, page 37, to receive more information about any product advertised, any new literature or new product described. Circle the number on the postage-free card that refers to the item of your interest, add your name and address and mail.

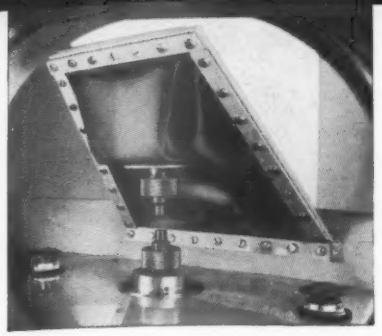
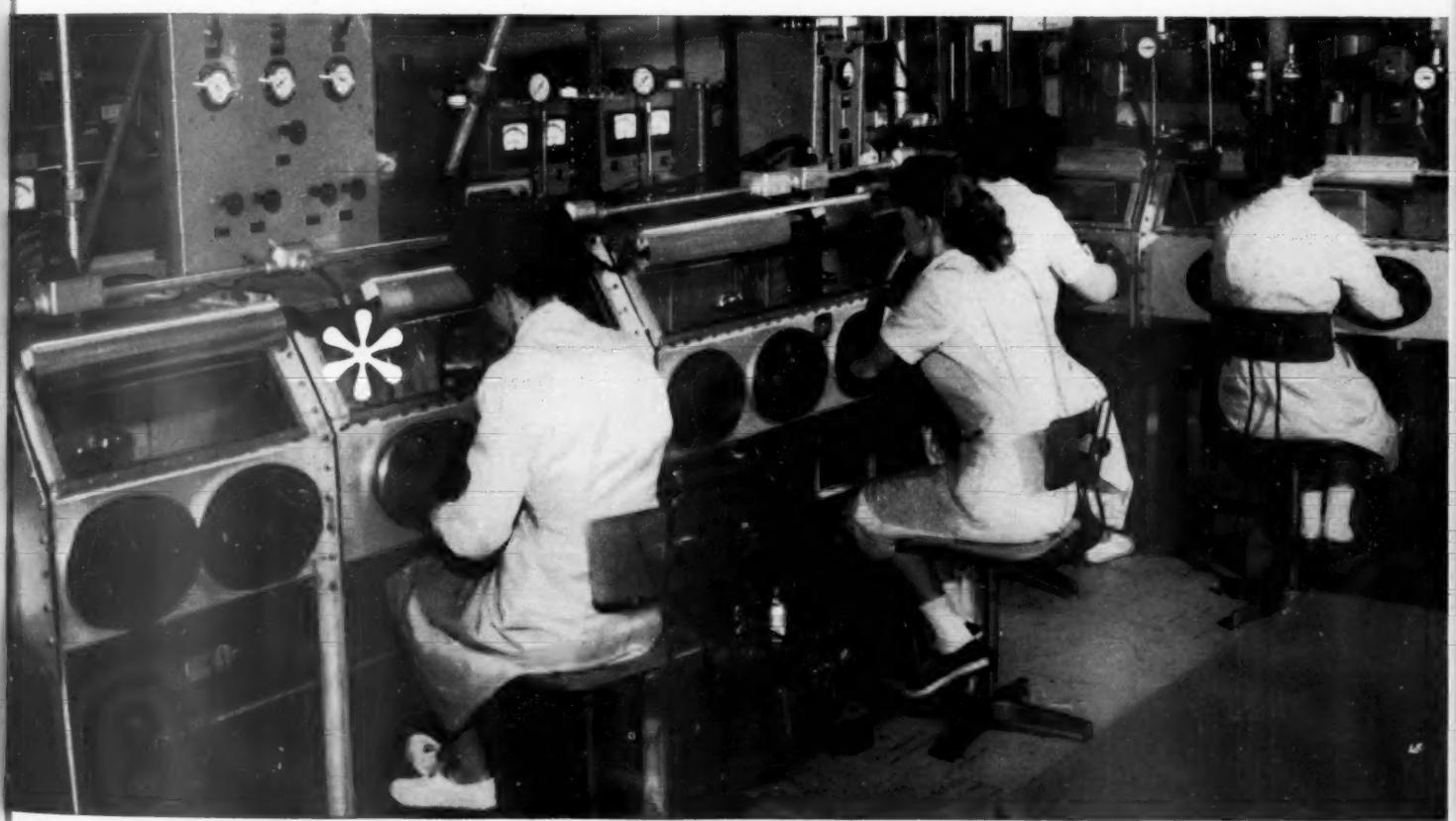


PHOTO AT LEFT shows welding installation in a Philco drybox. Photo below shows a building-block combination of Philco controlled atmosphere equipment. Both dryboxes and vacuum ovens are available in hermetically coupled straight line, "L", and "T" shaped configurations.

WELDING OR BAKE-OUT...

You Can Do Almost Anything in PHILCO Controlled Atmosphere Equipment...With Highest Hermetic Reliability!

For any process requiring critically controlled atmosphere, check Philco. Whether you require a complete system, or individual dryboxes, vacuum ovens or dust shields, you will find many extra-reliable features in Philco equipment. Philco designed a new standard because no conventional equipment met Philco's own atmosphere control requirements. Philco controlled atmosphere equipment is production-proved, available at competitive prices—including factory service. For detailed information, write Dept. AE961.



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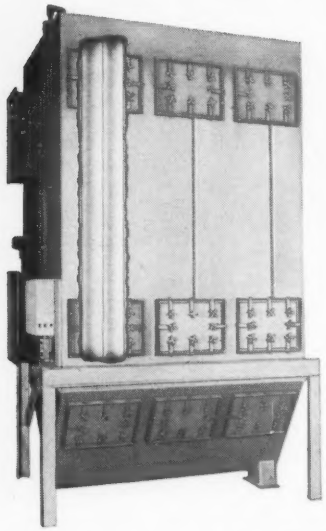
[For more information circle #15 on page 37 reply cards]

NEW DUSTEX "INDUCTAIRE" FABRIC-FILTER DUST COLLECTOR



Dustex "Inductaire" Filter Collector, Model 20-8-3. Sizes to meet all capacity requirements. Equipped with suitable filter fabrics to handle any dust problem including high temperatures up to 550°. Model shown with 8' bags. Larger models equipped with 12' and 25' bags.

GENTLE BUBBLE-ACTION ELIMINATES THE "DUST TRAP"

- **more effective, shorter cleaning cycle maintains system volume with minimum fluctuation**
- **higher air/cloth ratios in less space greatly reduces first costs**
- **longer fabric life—no damaging shakers or blow-back mechanisms**
- **lower maintenance costs—dampers operate in clean air ducts only—no other moving parts—bag changes easier, less frequent**

Only gentle air action on the fabric—virtual elimination of trapped dust...that's the amazing combination achieved by "Inductaire" bubble-action, introduced by Dustex to reverse air cleaning. No violent shakers, no fabric-damaging friction of any kind...yet, each bag is thoroughly flexed, purging it of the dust usually trapped by reverse air collapsing. Resulting increases in air/cloth ratios, plus many other Dustex engineered features, add up to less space requirements, reduced first costs, lower maintenance and operating expenses. Now, the 99.9+ efficiency of filter collection is yours at savings never before possible!

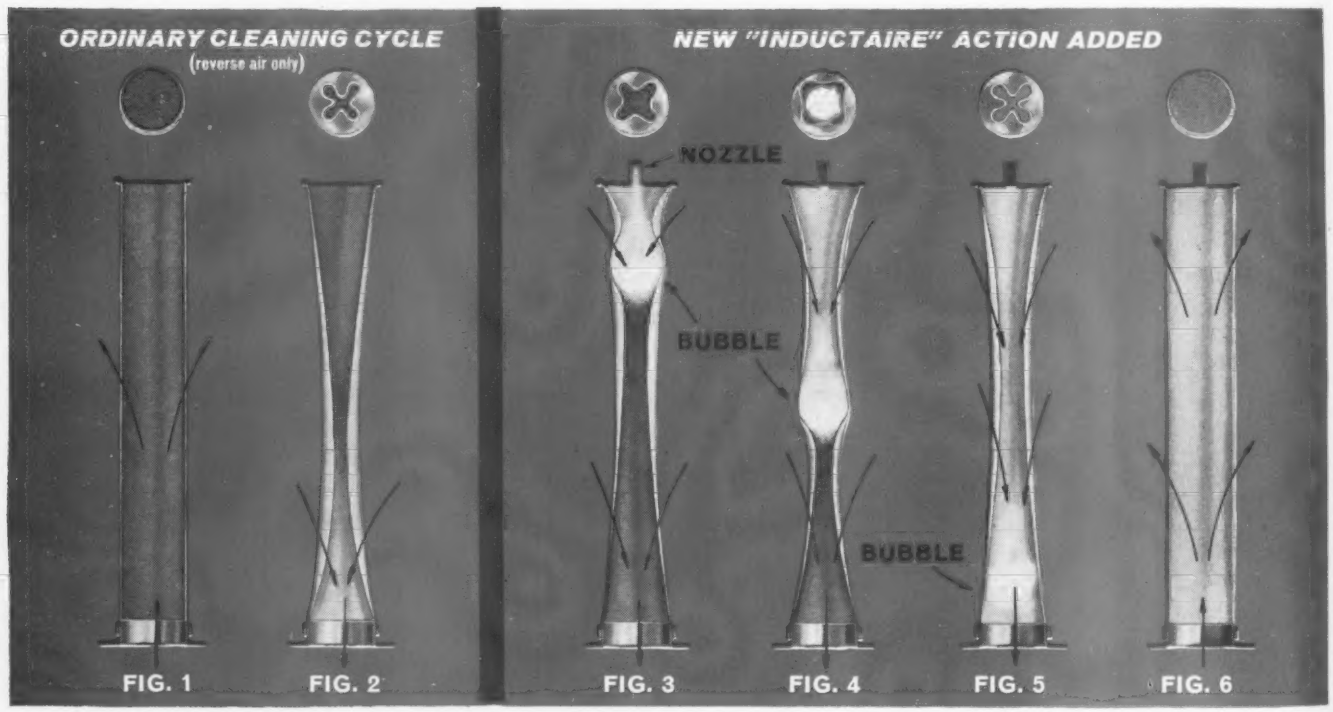


FIG. 1 Dust cake builds up to point where cleaning is required.

FIG. 2 Reverse air flows through fabric, collapsing tube in pleats until only small cone remains at bottom through which air can move. Dust cake is cracked by this action but much of it is trapped in upper portion of tube. This is the usual reverse air system used for many years in collectors capable of air/cloth ratios in the range of 2 cu. ft./sq. ft.

FIGS. 3 & 4 Addition of unique "Inductaire" nozzle in bag cap, increases air/cloth ratios up to 10 cu. ft./sq. ft. and higher. After usual reverse air cycle collapses bag, nozzle releases short pulses of air inducing additional air currents through the top of the bag, creating an air bubble that flows downward, opening the collapsed tube and purging the dust cake into the hopper.

FIG. 5 Reverse air flow continues, causing tube to again collapse producing further cleaning action on the fabric. Steps 3, 4, and 5 then repeat as many times as required (usually 3-5 impulses) for the dust handled.

FIG. 6 The brief cleaning cycle; about 20 seconds, is complete, with the tube back in normal filtering operation.

"Inductaire" represents the latest development by Dustex to offer the finest in filter and centrifugal dust collection equipment for every dust problem. Write for particulars on the complete Dustex line and engineering services ready to help you.

Dustex CORP.

P.O. Box 2520 • BUFFALO 25, NEW YORK

The company with the big name in dust collection

[For more information circle #16 on page 37 reply cards]

AIR ENGINEERING

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EDITORIAL:

Toward Better Building Codes . . .

BUILDING CODES, designed to protect the public against unsafe buildings, generally are hard to update to insure this worthy objective efficiently and economically. It sometimes takes a major disaster, like the Chicago amoebic dysentery epidemic that killed so many people, Texas ("Hello Sucker) Guinan among them, to get these codes changed to reflect the light of modern engineering practice.

The Chicago incident occurred during the gigantic Century of Progress Fair in Chicago in 1933. A maintenance worker turned off the water in the Congress Hotel to repair a plumbing fixture. Negative pressure in potable water pipes, caused by draining water from them, created enough of a vacuum to bridge an air gap an inch or more, sucking water from water closets back into the drinking water plumbing system.

Death stayed in the pipes all night. Guests drinking water or brushing their teeth before pipes were fully flushed by water usage succumbed to amoebic dysentery. Many died.

Only after this incident did changes occur in plumbing codes that made vacuum breakers on water closets mandatory. Vacuum breakers, though, had been *available* for many years prior to 1933.

Many of our present-day building ventilation codes, while not harboring necessarily lethal, archaic situations, like the Chicago 1933 incident, certainly are bars to progress.

Many of the school ventilation codes which require a ridiculous amount of outside air add needless expense to school buildings, for instance. Normal infiltration will take care of most ventilation needs for oxygen replenishment, and activated charcoal filters can remove odors, thereby saving much fuel otherwise wasted by heating outside air, and reducing cost and complexity of the air handling system.

In view of all of the obstacles associated with getting codes changed to reflect modern materials and methods, the action taken recently by the Chicago Association of Consulting Engineers deserves approval and imitation by other local consulting engineering groups.

The Chicago Association has, according to Mr.

(Please turn to following page)

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√ TROUBLE-FREE
√ LOW-MAINTENANCE
HEATING SYSTEM . . . GRID

GRID Cast Iron Construction resists corrosion externally from acid fumes and internally from electrolysis. No leaking from rotted cores.

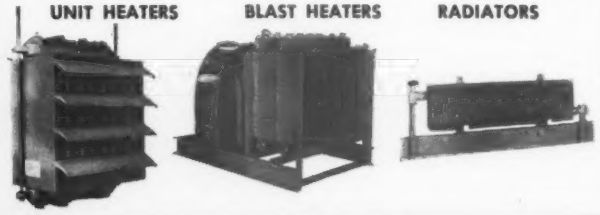
GRID one-piece cast iron heating sections and headers are leakproof on steam pressures up to 250 p.s.i. 450° temperature. Smaller steam lines cost less.

GRID heating sections with widely spaced fins cast integral with steam chambers are easy to clean — Will not "mat" on air intake side.

GRID design develops low outlet temperatures and with proper fan volumes, delivers warm, comfortable air to floor — No wasted heat at ceiling.

ask ASK for complete information on GRID Cast Iron Steam Heat Transfer Surface . . . write for catalog #956.

INSTALL GRID CAST IRON
UNIT HEATERS BLAST HEATERS RADIATORS



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Editorial (Cont.)

(Continued from preceding page)

R. J. Abramson of the C.A.C.E., formed a committee "for the study and re-examination of better and safer construction methods for the protection of public health, safety and welfare." Mr. Abramson is chairman of this committee.

The C.A.C.E. committee, says Mr. Abramson, is prepared to assist with technical advice "in these five fields":

1. Revisions and modernization.
2. Assistance in writing of building code revisions.
3. Engineering evaluation for compliance with building codes in force.
4. Aid in determining the extent of violation of existing local building codes.
5. Public service to law enforcing bodies, blue ribbon jury duty, expert witness, etc.

Mr. Abramson calls for a "Unified construction code having national recognition, and engineering codes written and interpreted by practicing engineers."

He points out that "there are several hundred heating and ventilating codes in force, many only with slight variations."

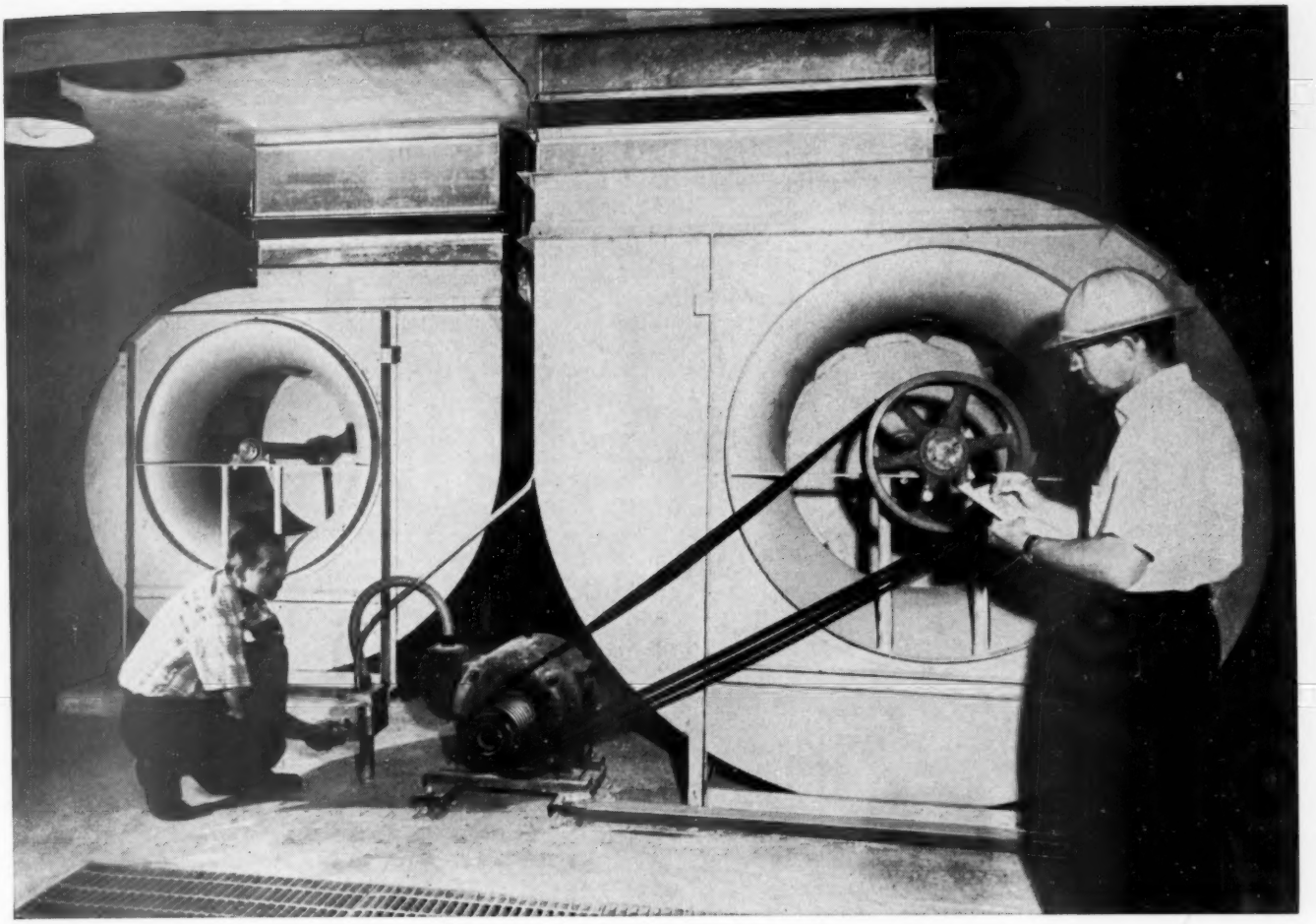
Mr. Abramson calls for properly trained building inspectors. These enforcement officials, he says, should have the proper work experience and good judgment in application and construction of devices he is to inspect. A municipal inspector should be a man with engineering training, on-the-job construction experience and be able to "adopt his judgment of the construction for each particular design."

Mr. Abramson, for the C.A.C.E., calls for "a two-fold program of code unification and better trained personnel to provide the American public with a safer, more integrated system at lesser cost which would probably eliminate arbitrary rulings based on inflexible and antiquated local codes."

"Codes should be formulated by joint effort and joint review of the Consulting Engineers Council, Engineers Council, A.S.H.R.A.E., A.I.E.E., I.R.E., A.S.M.E., A.I.C.E., etc. as they affect and/or join the specific engineering fields."

We urge professional engineering groups in other cities to take the same constructive, helpful attitude toward modernizing building codes. We'd welcome information on local engineering group activity toward better codes for publication in these pages, as our contribution to the solution of the code problem. ▲▲

Eugene A. Sloane
Editor



"Bacteria Tight" *Peerless Electric*® Blowers

135 OF THEM ASSURE CONSTANT VENTILATION AT NATIONAL ANIMAL DISEASE LABORATORY, U.S. DEPARTMENT OF AGRICULTURE, AMES, IOWA

• A constant supply of fresh air and an equal amount of exhaust air are of critical importance at this 14-million-dollar installation. Lack of proper ventilation would seriously undermine the success of any experiment being conducted here. For every group of supply and exhaust fans and blowers, there is stand-by equipment of identical capacity. Blowers are welded "bacteria tight" and duct work is sealed to prevent any contamination from one research section to another. Entire installation is capable of delivering 1,042,375 cfm at capacity operation.

ARCHITECTS AND ENGINEERS: Ralph M. Parsons Co., Los Angeles, California
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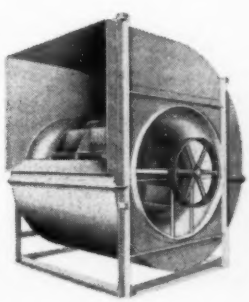
Manufactured and sold in the western states by Master Fan Corporation, H. K. Porter Company, Inc., 1323 Channing Street, Los Angeles 21, California. NOW AVAILABLE —Centrifugal Blowers to 132" wheel diameter, Turbo Blowers to 55 S. P., Tube and Vaneaxial Blowers and Industrial Fans to 104" wheel diameter.

Investigate Peerless Air Moving Equipment Today! Write to Peerless Electric Division, H. K. Porter Company, Inc., 1404 West Market Street, Warren, Ohio.

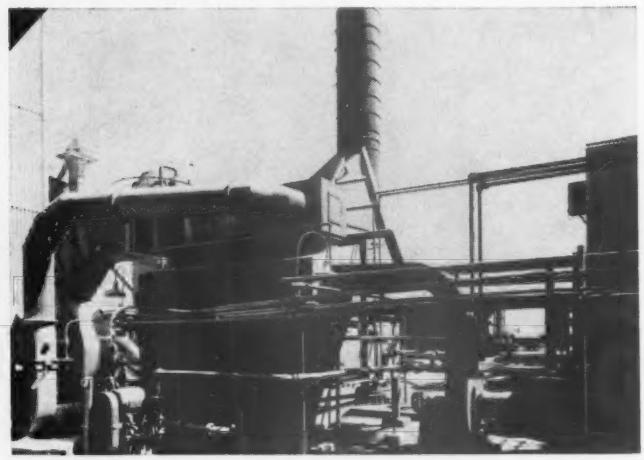


PORTER **PEERLESS ELECTRIC DIVISION**
H. K. PORTER COMPANY, INC.

Member—Air Moving and Conditioning Association, Inc.

[For more information circle #18 on page 37 reply cards]

NEWS of the Industry



Scrubber used by Valley Nitrogen Producers with 95 percent efficiency on concentrations in range of 1 to 2 grains per cu. ft.

Scrubber Cleans 40,000 cfm From Ammoniator Dryer Screen

The big scrubber shown above is installed at the Valley Nitrogen Producers, Incorporated at Helm, California. Unit handles 40,000 cfm of gases from an ammoniator dryer screen and transfer points dust pickup.

Scrubber is a Turbulaire size 4-26 made by Western Precipitation Division of Joy Manufacturing Company and provided with a mild steel shell, rubber lined.

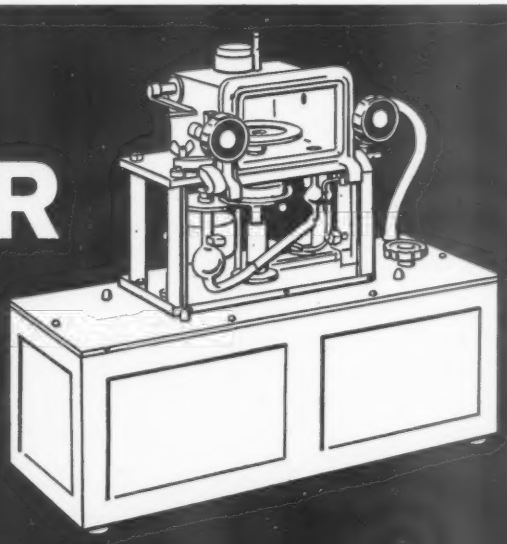
The scrubbing liquid is dilute sulphuric acid. The unit was designed to remove 95 percent of the dust delivered to it with concentrations in the range of 1 to 2 grains per cubic foot and pressure drop, 7 in. to 9 in. W.G.

The piping for the scrubber is arranged for complete recycle or partial bleed-off. As the concentration of dust and acid builds up in the scrubber liquor, the overflow is directed to the process or to storage. There is a fresh water inlet to balance the bleed-off and this fresh water is introduced through the back of the scrubber or through sprays located over the inlet.

The handling of the liquor here is a novel one, since they are able to get either complete recycle, complete bleed-off, or complete flow to

(Please turn to page 14)

SLIT SAMPLER



Made in England by CASELLA, the Slit Sampler can be applied to most problems of collecting airborne bacteria under controlled fully reproducible conditions. Portable, rugged, simple to operate.

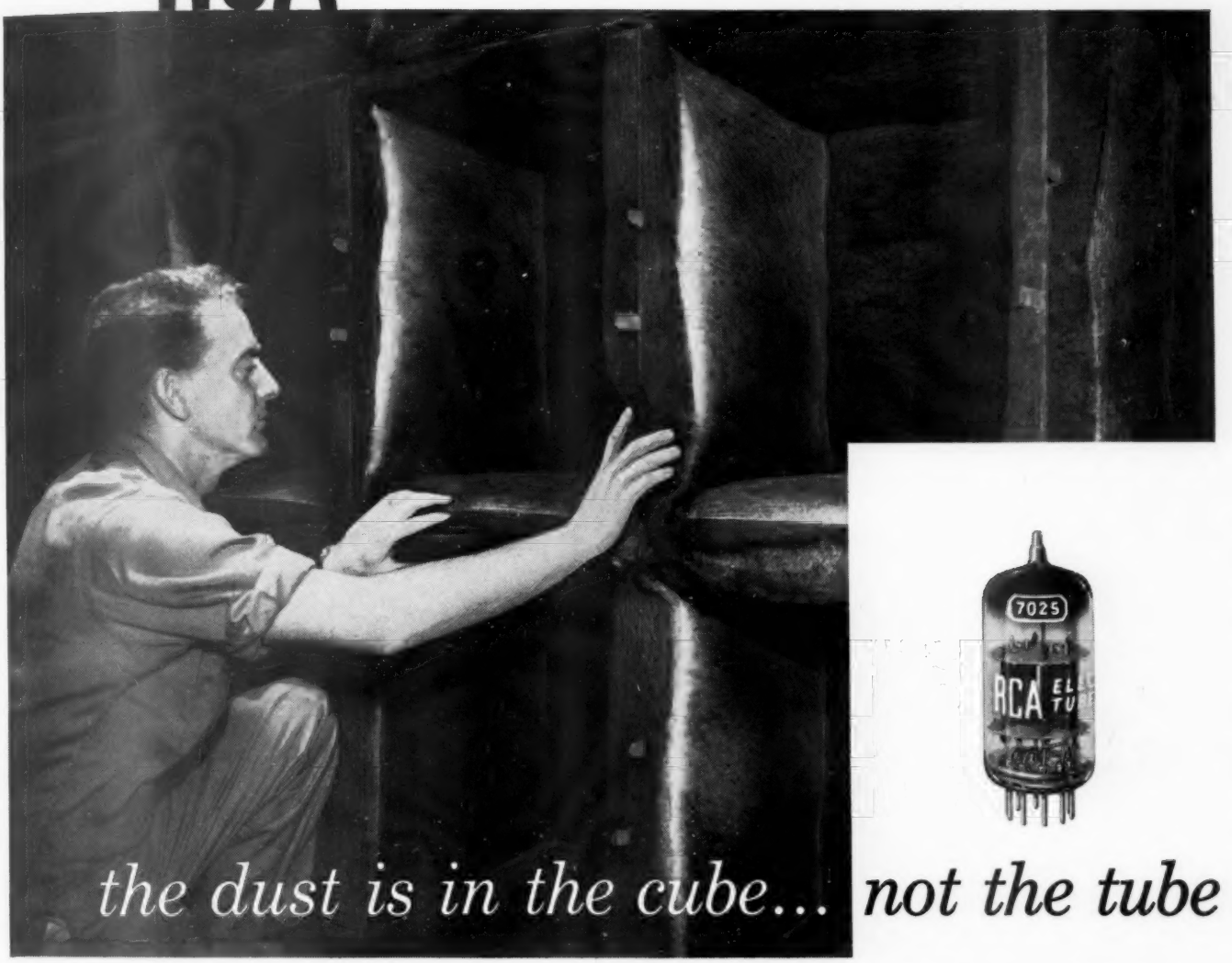
SEND FOR COMPLETE DESCRIPTIVE CATALOG

BRINKMANN

INSTRUMENTS INC., 115 CUTTER MILL RD., GREAT NECK, N. Y.

[For more information circle #19 on page 37 reply cards]

at RCA



the dust is in the cube... not the tube

Air clean enough to breathe could contaminate a miniature vacuum tube. For maximum filtering efficiency a pre-filter precedes an electrostatic precipitator at RCA's electron tube plant in Harrison, N. J. Recently, an increased heat load required an increase in the velocity of air—from 600 ft. to 800 ft. per minute—to pass through the pre-filter. This meant changing filters every two weeks. RCA required greater filtering efficiency and longer filter life without a major overhaul of the system, and UNION CARBIDE had the answer!

UNION CARBIDE's new ULOK Cube Filter provides .06 WG resistance (clean) and *four months freedom from maintenance* before the .5 WG resistance requiring a filter change is reached. Furthermore, since this new filter stops particles as small as 3 microns, there is a noticeable reduction of particulate matter on the ionizing wires of the electrostatic precipitator.

ULOK Cube Type Air Filters are delivering similar performance in major installations everywhere. Fashioned of DYNEL modacrylic fiber—a dry unoiled medium which may be vacuum cleaned—these unique filters are unexcelled for stopping and holding unusually large quantities of dust, dirt, and foreign matter. In addition, their exclusive open-box shape provides far greater filtering area than conventional filters with the same face dimensions, permitting use in high-velocity applications with the efficiency of low-velocity operation. And . . . they last *6 to 12 times longer* than other types of air filters.

Available in a wide range of sizes and shapes—cubes, panels, rolls, and pads—ULOK Air Filters are suitable for both new and modified systems. For detailed information on the complete line of ULOK Air Filters, including efficiency and pressure-drop charts, write:

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UNION CARBIDE DEVELOPMENT COMPANY
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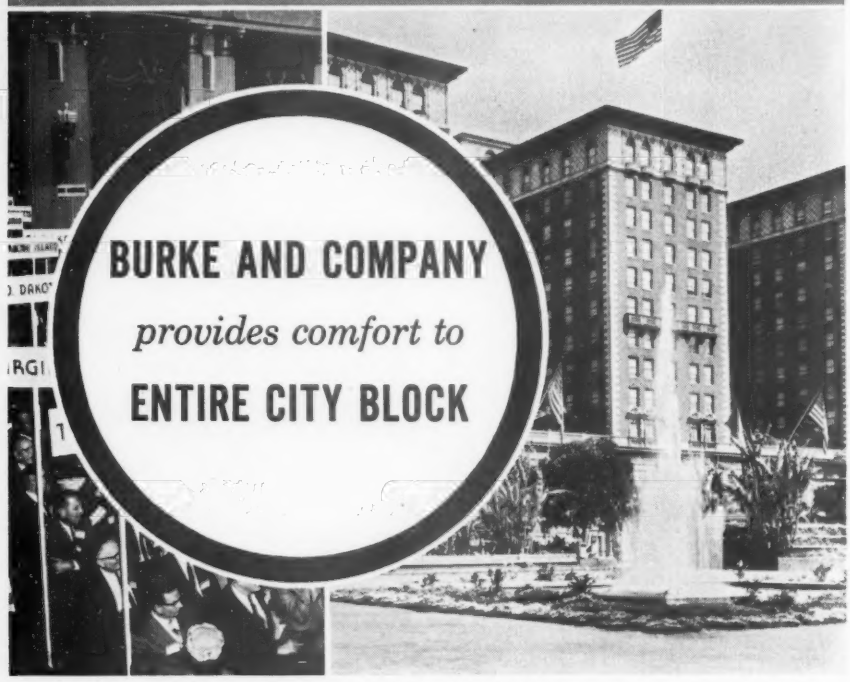
[For more information circle #20 on page 37 reply cards]

Where people gather...CLEAN PURE AIR is VITAL



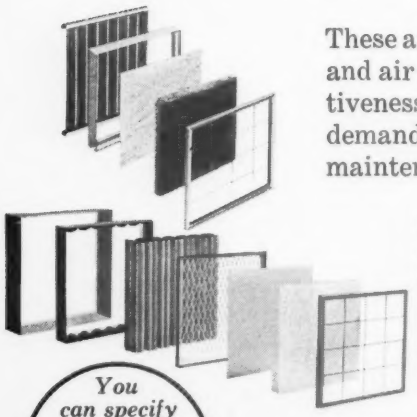
ARCHITECT: Heitschmidt and Thompson, AIR CONDITIONING CONTRACTOR: Air Conditioning Company, Inc. (Southern California), MECHANICAL ENGINEER: J. L. Hengstler

• At The Biltmore Hotel in Los Angeles, an atmosphere of clean, pure air is thoughtfully provided for guests and staff.

In the public areas, where it is necessary to permit entry of large amounts of vitiated outside air, combination replaceable media air filters and total detention type gas and vapor adsorbers by Burke are being used.

In the guest rooms, where 100% of the air is recirculated, combination replaceable media air filters and partial detention type gas and vapor adsorbers are in operation.

ROTOAire® CLEANS AND PURIFIES OVER A BILLION CUBIC FEET OF AIR DAILY IN THE BILTMORE HOTEL!



These are the advance design air filters and air purifiers that deliver the effectiveness, efficiency and dependability demanded by all modern building and maintenance programs.

They are readily adaptable to all new or existing installations.
They are available in a wide variety of sizes.
They may be operated at varying velocities and with various combinations of media.
The initial cost is low, but even more important . . . the maintenance cost is low.

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[For more information circle #21 on page 37 reply cards]

NEWS

(Continued from page 12)

storage accomplishing whatever the needs of the process dictate. Ammonia pickup is good and the stack (except for a steam plume) is virtually clear.

Summary:

Air Pollution Control In Northeastern States

In a report by W. H. Megonnell, Regional Air Pollution Consultant, Public Health Service, U. S. Department of Health, Education, and Welfare, Region II, New York, New York, he has catalogued an air pollution control summary of Northeastern States (Public Health Service Regions I and II).

Connecticut: Several cities have smoke-abatement ordinances, no State-level legislation relating to air pollution control. Firty-five communities with nearly 70 percent of State's population reported air pollution sufficient for residents discomfort.

Deleware: In 1957 an eight-member Air Pollution Authority, administered by the State Board Of Health, was created. Nearly 85 percent of the State's inhabitants live within Wilmington standard metropolitan area. Wilmington has a smoke-control ordinance but no air pollution regulations.

Maine: Few air pollution problem areas. No State laws, but some local abatement work is desirable.

Massachusetts: Legislature created a Metropolitan Air Pollution Control District in 1960, to replace 1910 Boston Smoke District. Air Pollution in each district is controlled by the State District of Health. Several local smoke ordinances, only one community has air pollution rules and regulations.

New Hampshire: State statute, administered by the Water Pollution Commission, provides limited tax exemption for equipment effective in water and air pollution abatement or control.

New Jersey: Several local smoke

(Please turn to page 16)

how to use duct furnaces for make-up air

Free from Reznor: Learn about this profitable use of duct furnaces along with other valuable information on make-up air in our just published handbook "What to Consider in Designing Make-Up Air Systems."

Manufacturing plants, chemical, food and material processors, restaurants, bakeries and dry cleaners are becoming increasingly aware of the need for make-up air. They now realize that bringing in clean, heated replacement air through a duct furnace can prevent undesirable drafts and the infiltration of dust, dirt and fumes.

Reznor's handbook on make-up air is one of a new series of Reznor Heating Handbooks to help you solve commercial and industrial heating problems. For your copy, published by the world's largest manufacturer of gas unit heaters, fill in the coupon and mail to Reznor. Or, for more information, call your Reznor distributor or nearby Reznor district office listed in the Yellow Pages under "Heaters—Unit."

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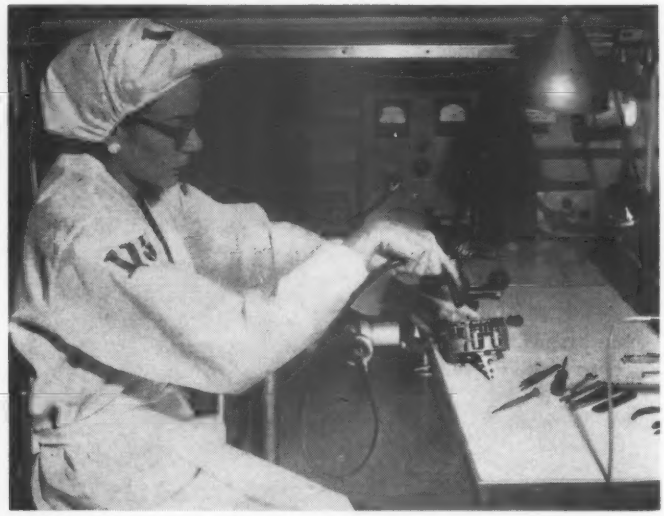
[For more information circle #22 on page 37 reply cards]

NOW--rid your White Room of the Unseen Enemy



If you're still using mops and brooms to clean your white room, chances are there's an unseen enemy lurking overhead or underfoot, ever ready to destroy high quality standards. The extreme care required for the assembly and testing of delicate instruments, precision devices and other equipment calls for special housekeeping techniques.

Hoffman vacuum systems get rid of the unseen enemy—solve tough production cleaning and general maintenance problems—provide maximum efficiency.

To insure truly superclean white rooms, call on Hoffman, pioneers in the development of engineered equipment for dust-free facilities. Hundreds of Hoffman white room systems in plants of all types say we know how.

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[For more information circle #23 on page 37 reply cards]

NEWS

(Continued from page 14)

abatement and air pollution control ordinances. Active State air pollution control program and the nation's first county smoke control agency in 1934. Nine-member Air Pollution Control Commission within the State Health Dept. with power to formulate and promulgate codes, rules, and regulations.

New York: Nine-member Air Pollution Control Board with authority created by law in the State Health Dept. Statewide air pollution control plan has been adopted. Following surveys, the Board may promulgate rules and regulations prescribing permissible degrees of air contamination in areas of the State.

Pennsylvania: Lehigh Valley Air Pollution Control organization and Pittsburgh and Philadelphia both have air pollution control programs.

New White Room Directory Underway

A Directory of suppliers of materials and equipment for use in White Rooms, Gray Rooms and contamination control generally will be included in the November, 1961 issue of AIR ENGINEERING.

Our first White Room Directory, published separately last year, has been so popular with our readers we are sure this more complete Directory will receive equally as warm a welcome.

There are thousands of firms in the missile, electronics, chemical, pharmaceutical, photographic and many other industries who are or will soon be spending hundreds of thousands of dollars building White Rooms, or their equivalent, for assembling everything from complete man-in-space capsules to semi-conductors, from tiny hearing aid components to giant klystrons for radar scanning systems. Such a Directory in the November issue will be the "Bible" for all engineers who are buying white room and contamination control equipment right now.

Although a questionnaire has

been mailed to all suppliers of contamination control equipment available to us, it is possible we may have missed some firms. If so, and your firm did *not* receive a Directory questionnaire, please write the Directory editor, who will be glad to send you one.

Gas Cleaning Directory Scheduled For Publication

Also slated for publication is a Directory Of Industrial Gas Cleaning And Dust Collection Equipment, to be featured in the December issue of AIR ENGINEERING.

Anyone interested in receiving a product questionnaire for Directory listing contact the Directory editor.

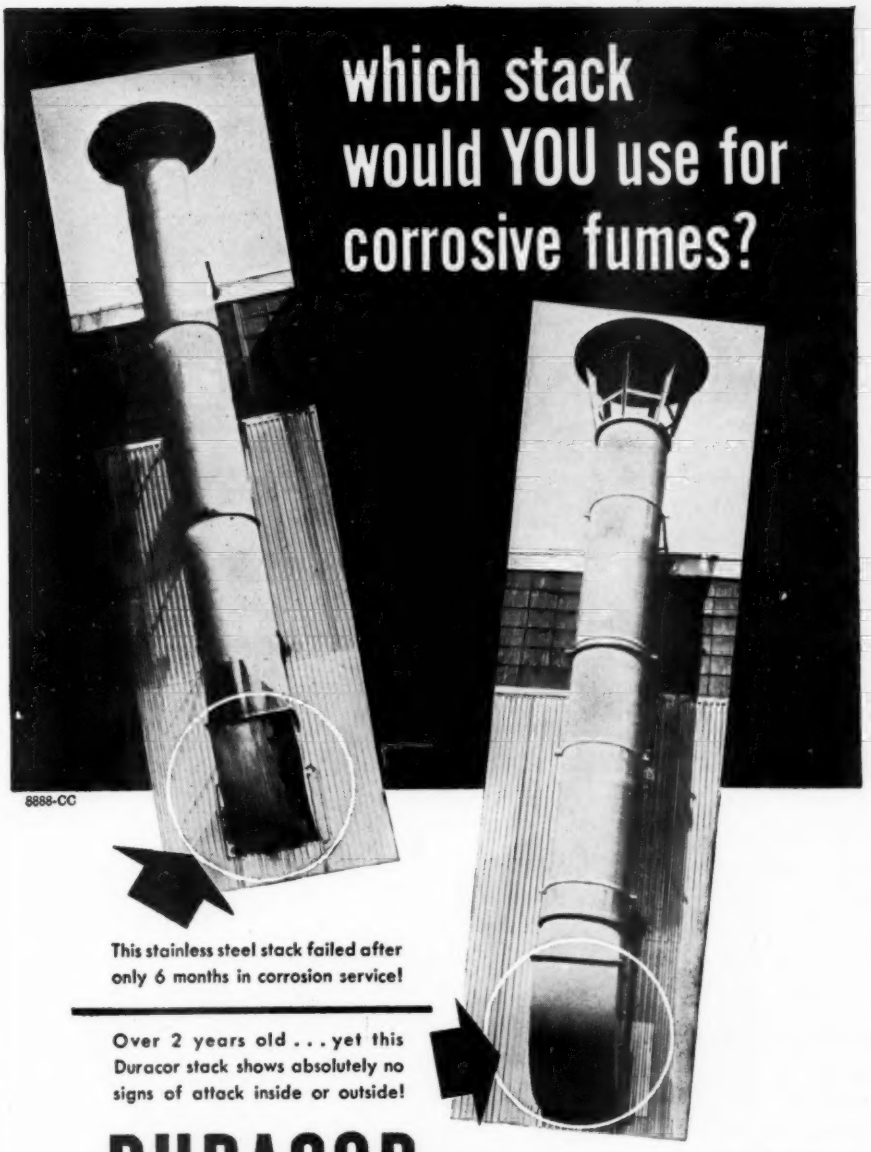
Ventilation Causes Noise Level Problem

The solution of one industrial hygiene problem may introduce another. Following is one of several examples of noise control in the steel industry given by James H. Botsford, Noise Control Engineer for Bethlehem Steel Company (Bethlehem, Pa.) at the American Industrial Hygiene Association's recent annual meeting in Detroit.

"The introduction of a 'powder washing' process for cleaning castings brought about need for additional ventilation to carry off heat and fumes produced when iron oxide powder was introduced into an oxygen-acetylene flame. Four propeller-type roof fans, each rated at 84,800 cfm free air delivery, were installed above the cleaning floor. Each fan had a blade diameter of 60 in. and was driven at 1,450 rpm by a 20 hp motor. Tip speed was 22,750 fpm or 380 fps."

The fans improved ventilation sufficiently, but complaints about fan noise soon presented another problem. Noise level on the floor below fans measured 115 db overall. Narrow band analyses revealed that the blade frequency of 97 cps was quite pronounced; harmonics of the blade frequency were detectable up to the seventh in diminishing amplitude. On the basis of these measurements a re-

(Please turn to page 20)


which stack would YOU use for corrosive fumes?
8888-CC
This stainless steel stack failed after only 6 months in corrosion service!
Over 2 years old . . . yet this Duracor stack shows absolutely no signs of attack inside or outside!

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Performance-proven Duracor Ventilating Systems and components provide outstanding resistance to attack from all types of corrosive fumes. These high-strength systems are corrosion-proof throughout . . . are practically immune to weathering . . . require only minimum support! Best of all, Duracor construction can save you up to 30% on your initial investment . . . and it's maintenance-free! Ceilcote engineers will design a complete Duracor system to meet your special requirements . . . or modify your present system to permit gradual conversion to Duracor. Fabricated to meet customer specifications . . . or assembled from stocked component parts . . . Duracor Ventilating Systems can be easily installed by regular plant maintenance crews or by experienced Ceilcote installation personnel. Write today for the new Ceilcote catalog.

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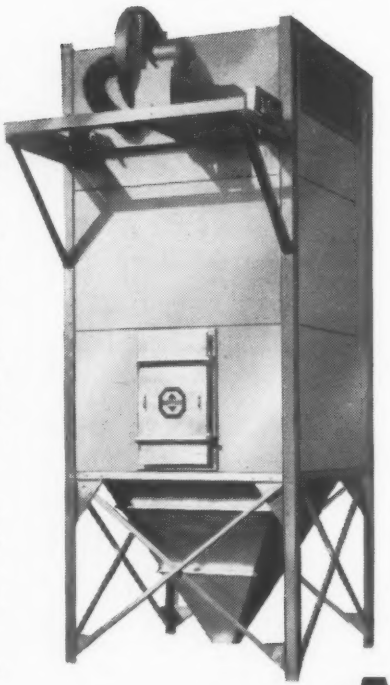
What should a filter filter?



The true test of a dust filter's efficiency is measured by the size of the particles it collects. Koppers new MODEL K AEROTURN *reverse-air jet* dust filter is virtually 100% efficient on sub-micron particles as small as 0.40μ. The dust filter that can cope with sub-micron particles will do a better job for you in these critical areas:

- *Good Community Relations.* The exceptional air cleaning efficiency of MODEL K AEROTURN meets strictest community codes . . . provides *maximum* employee protection, too.
- *Maximum "Product" Dust Recovery.* Retaining dust particles below one micron in size means *extra* product recovery for extra dollar savings, added operating profit.
- *Important Maintenance Savings.* Less labor, less time is needed for plant housekeeping with MODEL K AEROTURN on the job. Lower dust content in plant air means reduced machinery wear, longer life for working parts. Filtered air can be returned to plant for savings in heating and cooling.
- *Lower Air Filter Operating Costs.* Improved self-adjusting blow rings, proven pressure controlled filter cleaning reduce wear . . . increase filter tube life . . . cut operating costs. Rugged, simplified construction virtually eliminates maintenance and down time.

An efficient dust filter *must* meet your specific needs. Koppers engineers can do this for you. Write for a copy of our MODEL K AEROTURN brochure. KOPPERS COMPANY, INC., Dust Filter Dept., 4109 Scott St., Baltimore 3, Md.

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DUST FILTERS

Engineered Products Sold with Service

[For more information circle #25 on page 37 reply cards]

[Circle #26 on page 37]→

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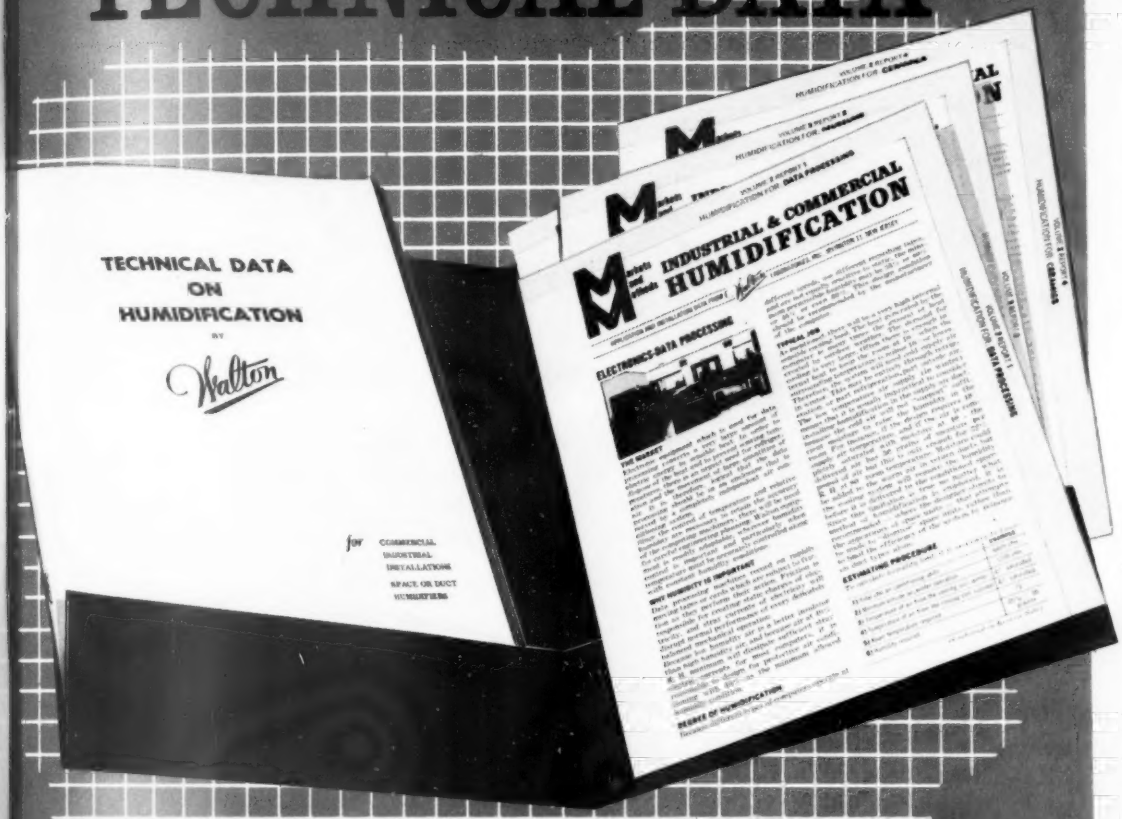

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and similar operations

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For an analysis of your dust control problem, call on Kirk & Blum's expert engineering service. Write today for complete information and a K & B survey.

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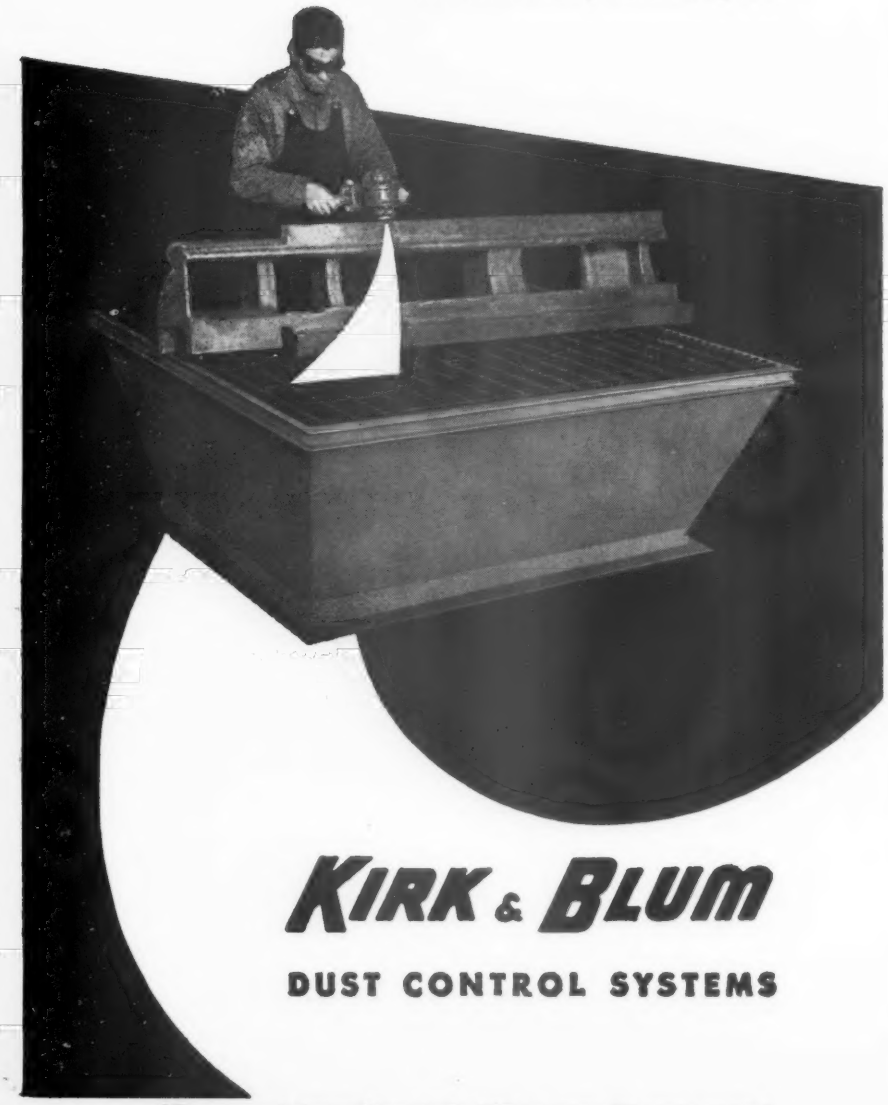


KIRK & BLUM
DUST CONTROL SYSTEMS

[For more information circle #27 on page 37 reply cards]

NEWS

(Continued from page 17)

duction in noise of 13 db was determined as a reasonable and adequate goal.

"After consideration of several noise control schemes, it was decided to install a muffler below each roof fan. A 'straight through' type was selected to keep interference with air flow to a minimum. Ventilation duct silencers, certified by the manufacturer to cause a pressure drop of only 0.18 in. water at a flow of 9,420 cfm, were selected to limit noise passage along the air stream. The estimated reduction in flow of nine of these silencers connected in parallel was only 10 to 15 percent. To connect the nine duct silencers to the fan inlet, a plenum was constructed with walls made of 14-gauge steel lined with 2-in. glass fiberboard. The plenum was designed so that the sound noise energy escaping into the foundry would not exceed the noise energy escaping through the air passages of the silencers."

Although calculated noise levels after silencing were not quite achieved, reduction in noise levels on the cleaning floor were considered satisfactory and worth the cost of $6,300 for quieting the four fans.

Air Conditioning Is Tax Relief For Air Cleaning Equipment

A bill to provide tax exemptions for air pollution control facilities has been passed by the Ohio House of Representatives and sent to the State Senate.

Opponents say the Bill would take tax revenues from communities. Proponents say the Bill would make the state more attractive to new industry.

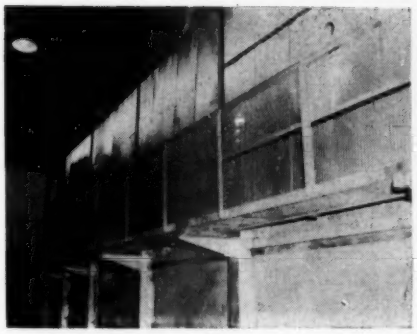
Use the Communications Center, page 37, to receive more information about any product advertised, any new literature or new product described. Circle the number that refers to the item of interest, add your name and address and mail.

Industrial Heat And Its Control

For relieving heat stress from hot jobs, part III discusses mechanical means of cooling plant personnel.

by Robert C. Lemke*
Industrial Hygiene Engineer, Michigan Dept. of Health

Part III



Above: This corrugated aluminum shield protects adjacent area from glass furnace radiant heat.

Above: Baffle slide in front of the furnace is pushed aside, so worker in aluminized and insulated clothing can knock out brick to check furnace batch of glass.

PART I COVERED theory of heat gain, benefits of heat stress relief and instrumentation. Part II took up methods of determining degree of heat stress and selection of methods for relieving industrial heat stress.

Ventilation

Mechanical ventilation for heat control may be general exhaust ventilation, local exhaust ventilation, or supplied air ventilation.

Moisture Control

In industries where there are operations or process equipment that saturate the air or emit steam such as paper machines, process tanks, and other warm, moist operations, the relative humidity is increased causing discomfort. Local exhaust ventilation can remove the process moisture directly from the operation before it has a chance to increase the relative humidity. Replacing exhaust air with a supply of drier and cooler outside air when it is available will increase the benefits still further.

Vapor absorption is another method commonly used to provide relief in warm, moist areas. The moisture-ladened location is supplied with a blanket of drier air that will absorb the process moisture. Supplying drier air must be done in conjunction with general exhaust ventilation. This requires larger quantities of supply and exhaust air than if local ventilation were used.

It's important to realize that unless the replacement air used during the winter months is tempered (warmed), rapid vaporization of the cold outside air will create an additional moisture, and sometimes a visibility problem.

General Ventilation

General exhaust ventilation, provided by roof exhausters and other large fans, cools by exhausting the heated inside air and bringing in fresh outside air at a temperature below room temperature. Roof exhausters are often misused. The worker is in the lower 8 feet of the plant, and unless the air flow going to the exhauster is directed through this area, little benefit will be received. There is no point in spending money to cool the upper region of a plant if no one is there to benefit by it.

The following can be used as guides for cooling with general ventilation:

1. Outside air temperature should be from 10-15 degrees below skin temperature (95°F).
2. Large volumes of air are generally needed.
3. Inlet openings should be designed and located to allow air to enter the lower plant regions. This is difficult to accomplish in larger interior rooms, particularly when machines or stacks of materials occupy much space and serve as baffles.
4. The effectiveness of the cross flow of air is decidedly limited when the buildings exceed 400 feet in width.
5. Prevent short circuiting of air flow to the exhaust fans by closing off all air entry into the upper regions of the plant.

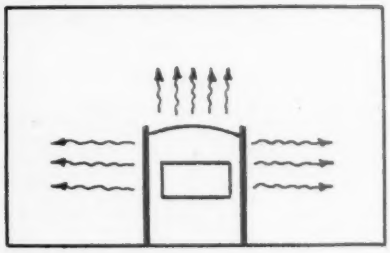
Air Supply and Spot Cooling

Greater coverage and distribution of outside air is obtainable by

(Please turn to page 22)

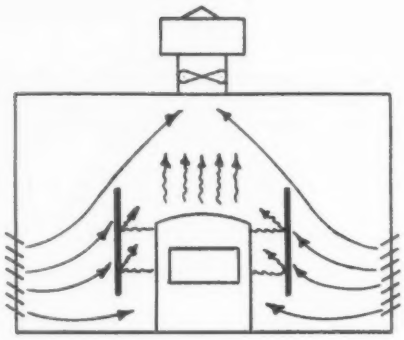
**Mr. Lemke is a graduate mechanical engineer and a member of the American Conference of Governmental Industrial Hygienists.*

POOR



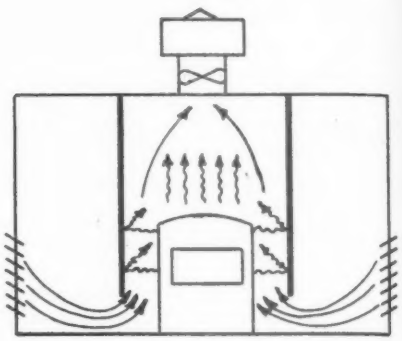
Shield is heated through direct contact with hot surface. It becomes source of radiant heat and heat is also transferred by convection and conduction. Radiant heat is a function of emissivity and is e=.11 for aluminum and e=.94 for black iron shielding.

BETTER



Radiant heat is reflected by the shields. Convective heat is exhausted while fresh outside air is supplied to working area.

BEST



Drawing above is best method because shield extends down near the floor level, permits more air to flow past inner shield surface.

(Continued from page 20)

supplying fresh air and mechanically forcing it into the lower regions. Outside air can be supplied at high velocities (800 feet per minute) directly to the exact point where it will do the most good. Increased air velocity also aids man's natural evaporation process. Outside air can be supplied with individual fans, simple ducted supply systems, or large central duct systems. Whatever method is used, the air should be ducted down to the 8 foot level or work station.

Central Duct Systems

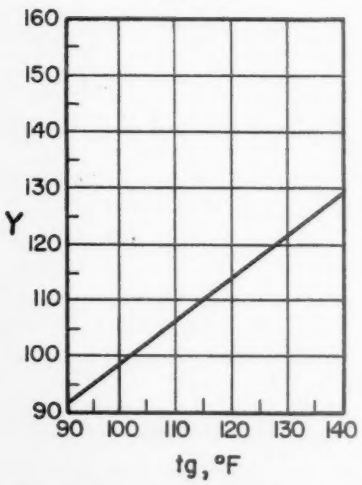
Central duct supply systems with appropriately designed and located supply grilles are becoming increasingly popular, especially where they are combined for use with the heating system during the winter months. Air supply outlets should be provided with adjustable grilles because different air distribution is desirable for winter operation than for summer. Where the outside air supply system is used for spot cooling a particular work station, the grilles should be arranged so that they can be adjusted by the worker to best suit himself. Air velocities for spot cooling work stations should range from 600 to 1,000 feet per minute. It is also advantageous to maintain duct velocities in the range of 2,000-3,000 feet per minute to avoid picking up additional heat while in the duct system. Reflective and insulated ducts also help decrease possibility of heat pickup.

The merits of the supply air system are being realized by more and more plants. Many of the plants have combined these cooling systems with their ducted heating systems.

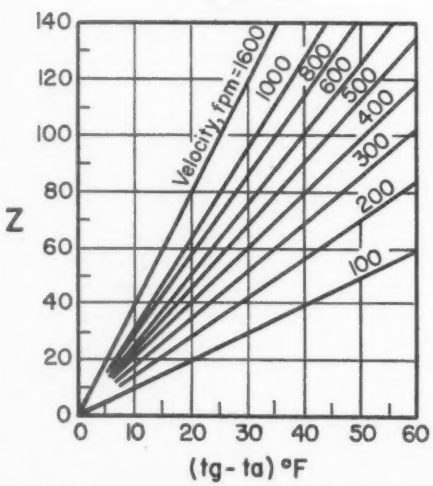
Man Coolers

Man cooler fans are limited in their effectiveness because they do not bring in cooler outside air. When inside temperatures are below 90°F, they do aid in cooling by increasing air velocity which is helpful to natural body evaporation. However, when the air temperature exceeds 90°F, they serve only to blast more warm air at the worker. Extreme caution should be taken to avoid using man coolers in areas requiring process exhaust ventilation because their air blast can upset the control of the ventilation system.

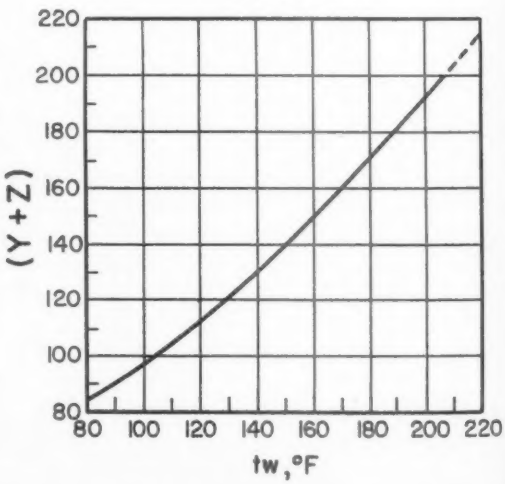
STEP 1



STEP 2



STEP 3



The charts above should be used with the calculations shown on page 28 of the August issue. They show how to find the mean radiant temperature of a source of radiant heat, such as a glass or steel melting furnace.

HEAT CONTROL METHOD	PURPOSE	APPLIED WHEN	REMARKS
Reflective Shielding	To reflect radiant heat. Place shield between source of radiation and person or area to be protected.	Radiant heat adds to the body heat load generally when the mean radiant temperature is above 95°F.	1. Sheet or corrugated aluminum is a good low cost reflecting material. 2. Additional benefit is obtained when convective heat in the area enclosed by the shield is exhausted out.
General Ventilation (Roof)	1. To remove convective process heat. 2. To allow cooler outside air to replace the exhausted warm air.	1. Convective process heat adds to the overall heat problem. 2. When outside replacement air temperature is low enough (below 90°F) to give inside cooling.	1. Replacement air should be directed to the lower 8 ft. level where it can sweep across the working area. 2. Wide buildings (over 400 ft.) and areas with large machines hinder the cross flow of air.
Local Exhaust Ventilation	To remove process moisture directly at the source.	Process moisture increases the relative humidity in the working area.	Tempered make-up air in amounts equal to exhausted air will be necessary for wintertime operation.
Vapor Absorption Ventilation	To remove process moisture from large areas by absorbing moisture with a replacement air having significantly lower relative humidity.	Process moisture increases plant relative humidity and cannot be exhausted with local ventilation.	1. Can be used in areas where dry replacement air is available. 2. 100 percent replacement air is necessary. 3. Tempered replacement air necessary for winter operation. 4. Large air volumes necessary. 5. Replacement air should be directed into working area below 10 ft. level.
Reverse Flow Ventilation Including Spot Cooling	To bring in cooler outside air at higher velocities.	1. Good air distribution to the lower regions of the plant is needed. 2. High velocity supply of outside air is needed to improve body evaporation. 3. High velocity cooling air is needed for spot cooling of specific locations.	The duct outlets for a reverse flow system (spot cooling) should be arranged to allow the worker to adjust the air flow to suit himself.
Evaporative Cooling	To lower the temperature of the outside air for distribution to hot areas in the plant.	1. A lower temperature cooling air is needed than can be obtained with the outside air. 2. Outside air temperature is above 90°F and will not give inside relief.	1. Evaporative cooling may be used for relief cooling in hot industries even in geographical areas where it would be impractical for general cooling due to high wet bulb temperature. 2. Wet bulb air temperature governs the effectivness of evaporative cooling systems. 3. Evaporative cooling should be used in conjunction with exhaust ventilation.
Air Conditioning	To lower the temperature of the inside air in the working area.	1. There is little process heat to add to the overall heat load. 2. Operations and processes do not require much mechanical exhaust ventilation.	Air conditioning can also be used to obtain humidity control to prevent corrosion and condensation.

Next month, the final and part four of this series of articles on industrial heat and its control will take up evaporative cooling, station isolation, air conditioning and give a summary of the entire series.

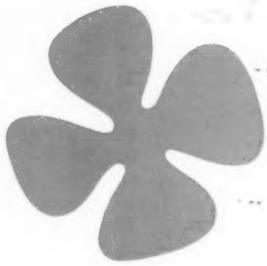
There will be ten illustrations showing poor, fair and good methods of cooling by general ventilation and means of introducing outdoor air through duct system.

An extensive bibliography on industrial heat control will also be given for reference use. ▲▲

This article tells you how to design your own make-up air system, with details on controls, data on equipment sizing and its selection, tips on problems.

by George W. Reznor
Vice President, Engineering
Reznor Manufacturing Co.

How To De



Make

FOR every cubic foot of air exhausted from a factory building, at least one cubic foot of air, usually tempered and filtered, must be supplied.

Without a balanced air condition in the plant, the very reason for exhausting air in the first place is nullified. If you remove air to vent harmful plating tank fumes (Fig. 1) and you don't add make-up air, you in effect cause the plating tank exhaust system to work against a vacuum created by its own operation.

The exhaust system won't work, you'll still have plating tank fumes and you may have other equally harmful side effects of this negative air pressure situation, not the least of which can be excessive heating bills. Table I pretty well sums up the need for adequate make-up air systems. This article tells how to design these systems.

Make-up air problems usually are the same in both new and existing buildings. The make-up air system itself varies in design only with the building operation, severity of seasonal changes in temperature, and geographical location. For practical purposes, this article deals with systems operating summer and winter, and located in areas with design temperatures below 35°F.

Every building, or operation within a building, presents peculiar and individual problems which must be analyzed so that the need for make-up air is justified in comfort and safety for the individuals in it.

The make-up air system also must be economically sound for the building operation.

Consider the problem of individual spaces within a building that require positive air exhaust. Exhaust in these spaces often is required because a particular process creates undesirable heat or air contaminated by fumes, odors, or particulate matter. This situation requires the most critical analysis for proper solution, since an exhaust system may draw contaminated air from another space, possibly upsetting the production process, or even threatening employee health.

One example of this is a woodworking facility located adjacent to finishing areas. An exhaust system usually is provided to remove dust created in the woodworking shop. The finishing areas also require exhaust for the paint sprays. If positive and clean make-up air is not provided to the paint area, contaminated air could be drawn from the adjacent spaces, upsetting the exhaust system in the woodworking area.

Another example is met where heated or air conditioned offices are located within a large storage area such as a warehouse. If the warehouse area is exhausted, its fans will pull conditioned air from the office spaces, upsetting the heating or air conditioning system and creating other problems with the air distribution system.

Areas with process furnaces also are usually supplied with large air exhaust systems, often resulting in as many as 20 air changes per hour. This creates a serious problem if no make-up air is supplied. The fans will draw replacement air from adjacent spaces, creating a problem when doors must be opened or closed. If the negative pressure is great enough, it may reverse the flow of gases in flues or chimneys.

Plan Before You Start

Before any make-up air system is designed, careful analysis must be made not only of the amount of make-up air required, but also of the type of system to be in-

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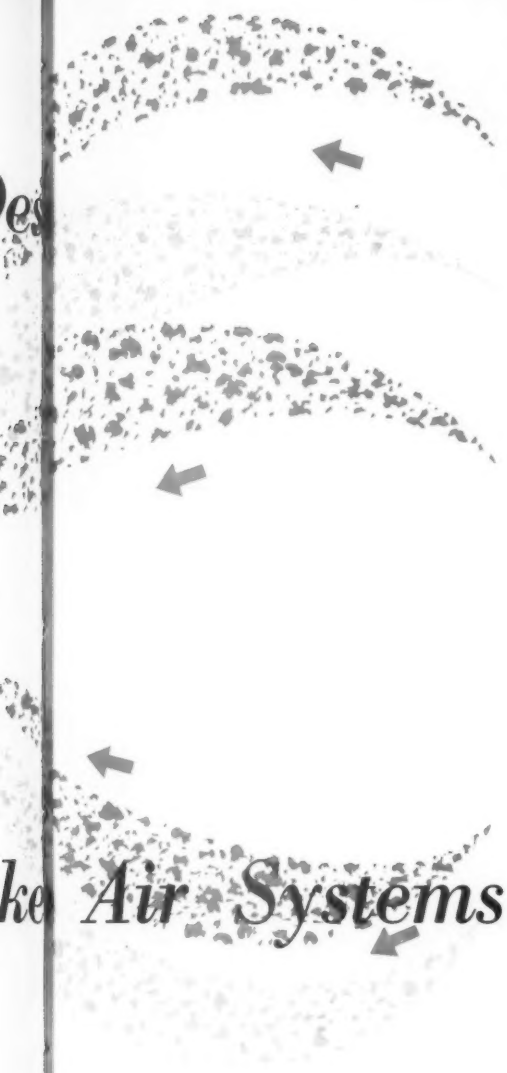
- No positive infiltration o cold
- Maximum fan efficiency a ele
- Product protection from c dirty
- Fuel savings due to impr ombu to overheat inner bays to cold
- More production from pro me
- Less housekeeping, less bec clean instead of leaking rough
- No danger of carbon mon eating into factory area, when p r pos
- No danger of cracked exc conditions.
- Maximum employee pro nst ventilation equipment. P gains compensation insurance.
- Doors easier to open un pre
- Positive odor control loca rce. nuisance odors throughout office



ke Air Systems

stalled, the expected operation pattern of the system, and how the system can best be adapted to the building's construction.

The basic item of any make-up air system is an air handling unit with a heat exchanger to temper the air. The equipment from this point is refined to meet the particular requirements of the operation. The air handling unit circulates the air, while the heat exchanger tempers the air. If clean air is a requirement, filters can be added to the system.

Consideration then must be given to air distribution. Ductwork must be installed if the air handling unit is remotely located. Grilles or diffusers can be added to the ductwork to insure good air distribution. This is the point at which building construction must be considered. Space must be available for the equipment and ductwork.

The heat exchanger can be controlled to temper the air as required by indoor and outdoor conditions. Selection of the heat exchanger which furnishes heat to temper the air should not be made until the following factors are fully considered: equipment and installation cost, operating and maintenance cost, replacement cost, equipment availability, fuel availability, versatility, code requirements, etc.

Here's How To Figure

Sizing and selection of equipment vary with requirements, but generally, are accomplished as follows:

¶ The amount of exhaust air must be calculated.

¶ Determine the amount of make-up air needed. This should always be slightly higher than the amount exhausted in order to maintain positive air pressure in the space. A figure of 110 percent of exhausted air is generally considered.

¶ Calculate the amount of tempering. The unit should be sized so that it is capable of producing a discharge air temperature a few degrees above room temperature. A maximum discharge temperature capability of from 75° to 80°F suffices in general, although the actual discharge temperature will be governed by the requirements of the installation.

¶ Compute the amount of heat required. This is the product of the amount of exhausted air (in cfm) and the temperature difference between entering air and discharge air, times the factor of 1.085.

Let us take, as an example, a room in which a process furnace is installed, and exhausting the heated air creates a negative air pressure. Suppose the room is being exhausted at the rate of 10,000 cfm. Average room temperature is 75°F and minimum outdoor air temperature is zero F.

Fan capacity of make-up air unit = 10,000 cfm × 1.10 = 11,000 cfm

Maximum make-up air temperature, $T_1 = 80°F$

Outdoor air temperature, $T_2 = 0°F$

Quantity of make-up air, $Q =$ 11,000 cfm

Constant, $K = 1.085$

H, heat load for make-up air in Btu/hr.

$H = Q \times K \times (T_1 - T_2)$

$H = 11{,}000 \times 1.085 \times (80 - 0)$

$= 955{,}000$ Btu/hr.

Selecting Equipment

Of the several types of heating available for tempering make-up air, direct gas-fired duct furnaces seem to offer several advantages.

First cost for equipment is generally no more—if indeed as much—as indirect-fired heaters with related boilers, piping and controls, or oil or electric heaters.

Installation costs for gas-fired duct furnaces are usually lower than for other types because it is much simpler. Installation involves a simple connection to ductwork. Piping connections are one pipe—compared with two pipes for other systems. Pipe insulation, traps, balancing fittings, drains and vents are *not* required.

If standby fuels are mandatory, duct furnaces can be obtained with dual fuel burners. Thus, they can operate on city gas or on standby with liquefied petroleum gas.

Maintenance and operating costs are very favorable. Occasional cleaning of the heat exchanger and burners are required. But these are simple operations, requiring no special equipment or skill, nor long periods of downtime compared with cleaning other types of exchangers.

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GOOD AIR CONDITIONS

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Fig. 1: Left, plating tanks in this plant are all concentrated in a 21,500 sq. ft. area. Make-up air must be supplied to replace air exhausted from this area by the hoods over tanks.

(Continued from preceding page)

Natural gas costs are usually favorable and a higher heat exchange efficiency is realized in direct-fired equipment as compared with indirect-fired equipment.

And if it ever becomes necessary to change units, as in the case of enlarging a make-up air system, equipment replacements are accomplished very simply. There is never any lost time due to draining lines. Central heating systems do not have to be shut down to permit tapping into mains.

System Operation And Control

Make-up air systems, as such, need operate only while exhaust fans are functioning. But in new buildings, the system can be designed for general heating as well as make-up air as shown in Fig. 2. A qualified consulting engineer can design a system to accomplish control of the outdoor air introduced into the system through automatic dampers, which may be set to vary the amount of outdoor air taken in by the unit.

If heating only is required, dampers will permit entrance of a minimum of outdoor air; when make-up air is needed, the dampers will permit entrance of maximum outdoor air. The outdoor air damper can be completely closed during unoccupied periods.

If a system is installed only for supplying make-up air, it can be controlled to operate only when the exhaust system functions. Make-up air systems should also operate during summer as well as winter periods, providing filtered air all year. This is a benefit that buildings with exhaust systems only do not enjoy.

Operating cost of the make-up air system in the summer consists only of the power consumed in driving the fans. In the winter, the

TABLE I—DESIGN CONSIDERATIONS FOR MAKE-UP AIR SYSTEMS

¶ The make-up air installation should not be considered as part of the building's heating system. It should serve only to replace exhausted air and to heat replacement air to room temperature. The system should be designed for summer and winter use, and is wired to operate from a simple wall switch or electrically interlocked with the air exhausting system fans.

¶ Locate the system close to an outside wall so duct runs can be kept short. Protect the air inlet with a ½ in. mesh screen and hood or rain louvers. Filters may be provided in the inlet duct when conditions warrant their use. An automatic gravity damper opens when the make-up air blower starts, to prevent cold outside air from chilling the heat exchanger and creating drafts when the blower is not operating.

¶ The blower should be sized to handle all the make-up air cfm load plus any static developed in the make-up air system (inlet duct, filters, distribution ducts, etc.). System pressure loss is usually low and can be handled by a relatively small motor and drives run at slow speeds,

¶ Outside air flowing over the heat exchanger during the colder seasons will cause condensate to form inside the heating tubes. This moisture can corrode ordinary or even coated steels and therefore, stainless steel heat exchangers are recommended. Corrosion is also promoted by the burners cycling on and off when the entering air temperatures are less than 40°F, and thus modulating control is necessary.

A duct furnace is recommended for make-up air systems. This furnace can have a stainless steel heat exchanger with a modulating gas valve which varies the height of flame and maintains a constant discharge temperature.

¶ Low firing rates and cold entering air chill flue gases below the temperature required for gravity venting. Therefore, make-up air systems should have a power-driven flue gas exhauster.

¶ The sensing element of the modulating gas valve should be placed in the discharge air stream so that it senses the average discharge air temperature and should be shielded by a baffle from radiant heat as illustrated. A room thermostat is not required.

¶ Make-up air should be discharged into the building at or slightly below room temperature to prevent interference with the normal heating system. The modulating valve has a control knob which may be adjusted for the desired supply air temperature.

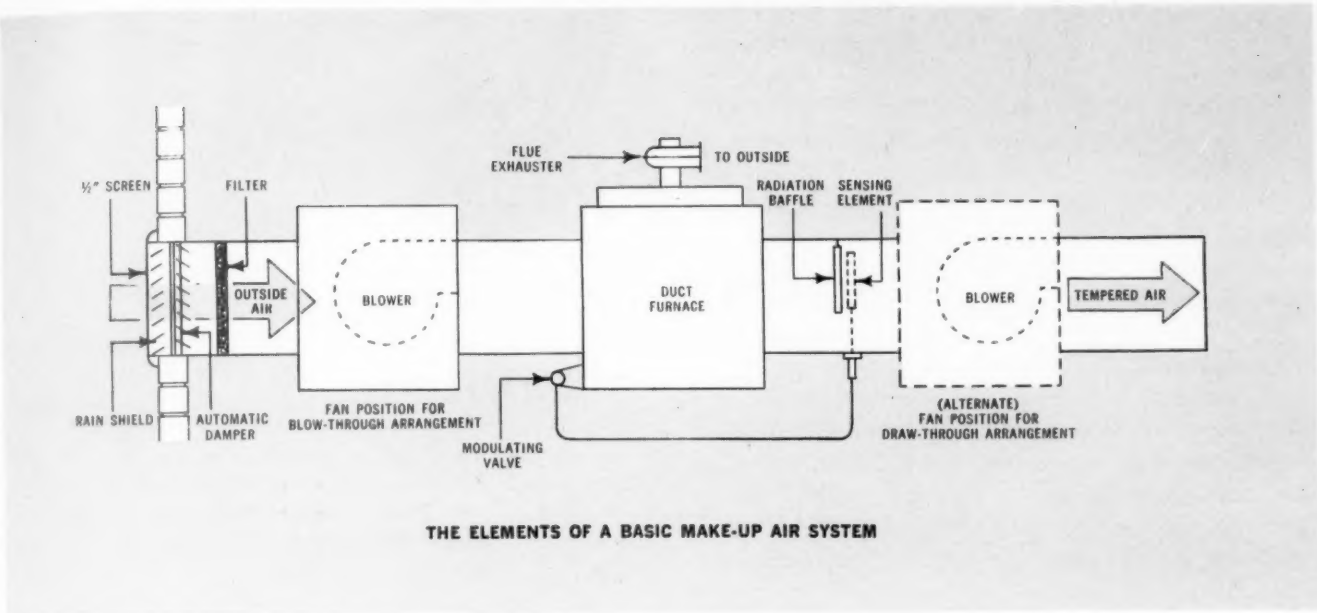

Fig. 2: Typical make-up air system showing heating coils, filters, intake, dampers, heat exchanger, blower and other component parts of system.

cost of fuel for tempering the air is added. In order to analyze this properly, consider the case of a building equipped only with an exhaust system. Infiltration of outdoor air adds to the cost of fuel consumption during cold months, since the existing heating system must overcome this heat loss to maintain temperatures in the spaces at a comfortable and healthful level.

By careful planning, with a make-up air system the amount of additional fuel consumed in winter can be controlled precisely to the point that it occurs only when desired or necessary. The benefits derived from the installation are well worth the investment.

Typical Control Arrangement

The control sequence illustrated in Fig. 3 and described below is typical of those used for direct gas-fired make-up air duct furnaces.

ON-OFF SWITCH: This switch can be either manual (wall switch type) or automatic (wired in parallel with controls to exhausting devices).

BLOWER: The blower operates continuously when system is in operation. Air for system is drawn from outside the building.

AUTOMATIC VALVE: Automatic valve is also controlled by on-off switch, giving positive electrical interlock between blower and duct furnace.

MODULATING VALVE: Modulating valve controls the rate of flow of gas to the main burner. The remote bulb temperature sensing element is located in the discharge air stream and modulates the gas input up or down to maintain a constant discharge air temperature. As outside air temperature increases, the valve modulates to a minimum gas input rate of 20 percent then snaps closed if the outside air temperature continues to rise. When two heaters are placed in tandem, the sensing bulb for the first should be set at the desired discharge temperature and the second sensing bulb should be set 3 or 4 degrees lower. Thus, the second heater will operate only when its additional capacity is required.

LIMIT CONTROL: The limit control is wired in series with the automatic valve. If the air flow through the system is interrupted or restricted, the limit control will break the circuit to the automatic valve. Gas flow to the main burners is then shut off until adequate air flow is re-established.

SAFETY PILOT SWITCH: Safety pilot switch is also wired in series with the automatic valve. In event of pilot failure, the automatic valve circuit will be broken. Gas flow to the main burners is then interrupted until pilot circuit is re-established.

REGULATOR: The regulator reduces line pressure to within operating pressures of 3.5 inches. Line pressures up to 8 oz. are re-

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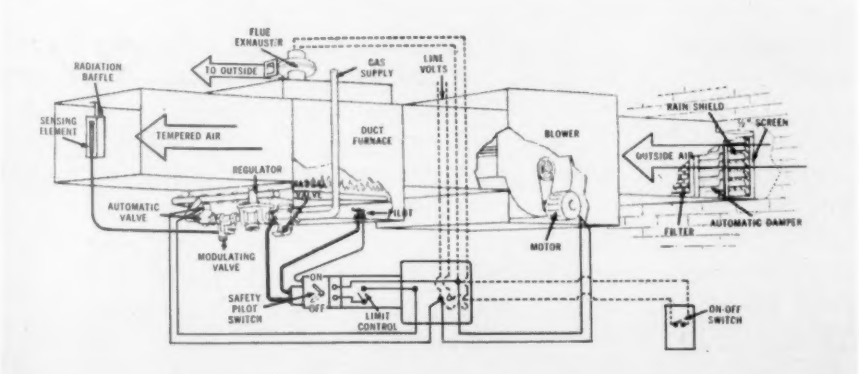
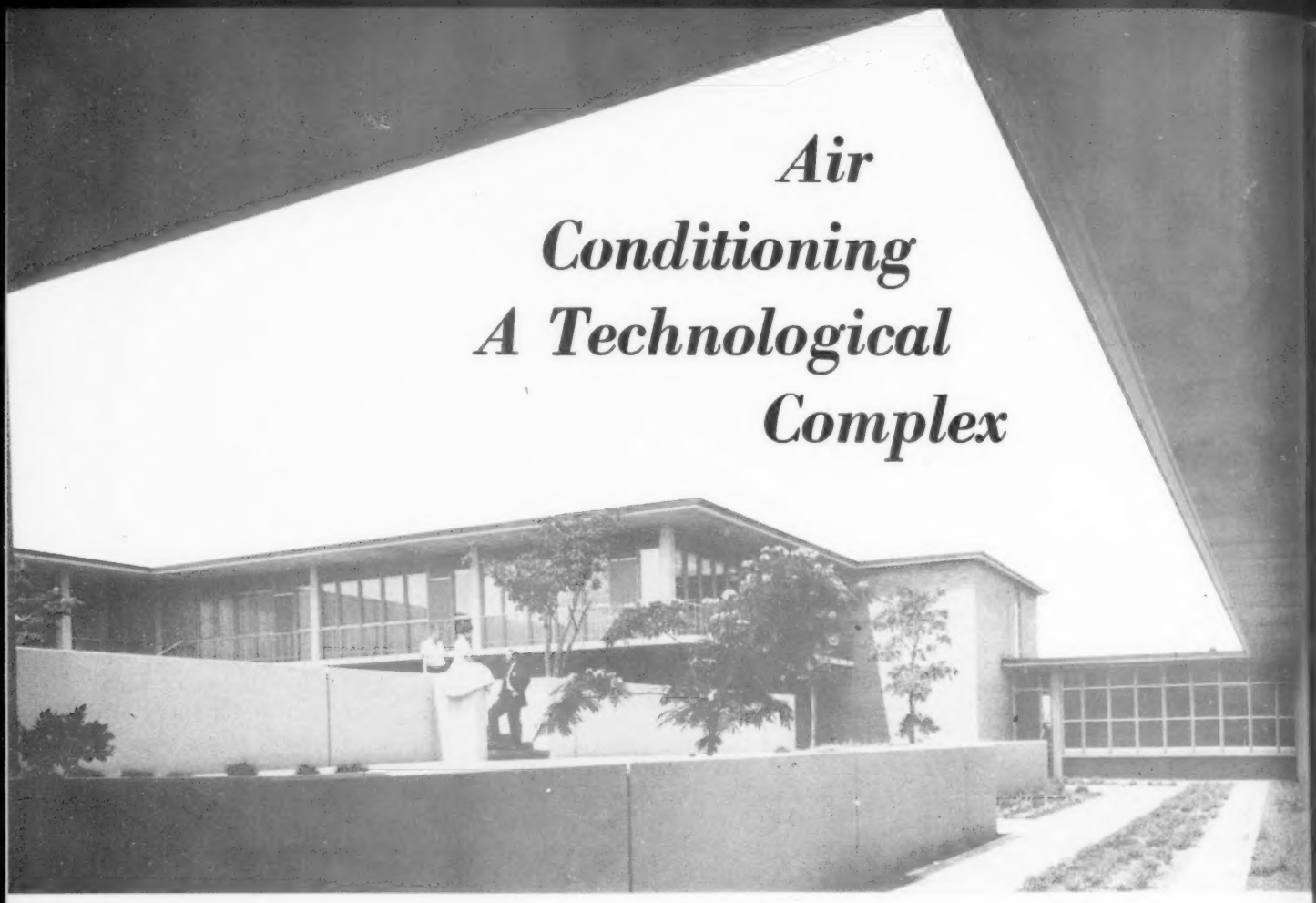


Fig. 3: Control arrangement includes burner valve, limit control, safety pilot, on-off switch, automatic valve, sensing element, modulating valve.



Air Conditioning A Technological Complex

First in a series on this big (800,000 sq. ft.) semi-conductor production facility describes unique air throttling device to meet a varying heat gain problem, fluctuating air supply requirements and exhaust of toxic gases with minimum loss of heating and cooling Btu.

by **Robert S. Sloan**, *Facilities Director, Texas Instruments Incorporated*, and **John B. Meek**, *Air Conditioning & Engineering Associates, Inc., Detroit, Mich., and Dallas, Texas*

A SYSTEM for completely and satisfactorily heating and cooling the many diverse areas making up a modern manufacturing, research, and administrative complex such as the new 350-acre development of Texas Instruments Incorporated in Dallas must be a near ultimate in flexibility, adaptability, and dependability.

The Texas Instruments development represents one of the nation's major technological and industrial complexes. Development of this site was started in 1957 and by early 1961 six major buildings with a total floor space of more than 800,000 square feet were completed and occupied. The master plan for this site envisages 12 to 15 buildings with a contemplated two and a half million square feet of space.

Since this project is still building, a new design factor, expandability must be added to those listed earlier as requirements for a satisfactory heating and cooling system.

To meet these requirements and design criteria, Texas Instruments facilities staff and its architect-engineers decided that a central plant for the production of chilled water and high temperature hot water, which could be pumped around this campus type site to the various buildings, would work out best. These basic heating and cooling media are introduced into building distribution systems individually tailored for each building's peculiar problems. Plus factors for such a central installation were a definite and sizable reduction in total equipment capacity required over

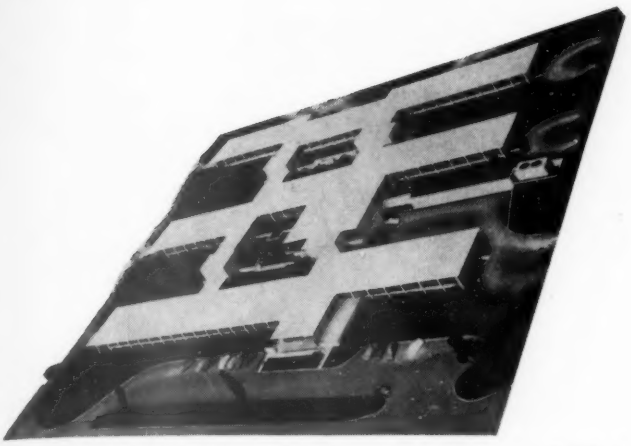


Fig. 1: Left and above, Texas Instruments new Central Research Laboratories are a thinking man's dream. Activities in laboratories posed some tough problems for the year-round air conditioning system designers.

individual plants producing the basic hot and chilled water located in each building and a substantial saving in operating costs.

This first of a series of articles covering this system will describe the unique air distribution system used in the company's Central Research Laboratories. Here an especially designed air throttling device solves problems of varying heat gain, fluctuating air supply requirements, and exhaust of toxic gases with a minimum loss of heating and cooling Btu.

In a subsequent article the air distribution problems in the Transistor Products division and Components division plant where electronic devices such as transistors, diodes and capacitors are made under rigidly controlled conditions of temperature, humidity, and air movement, will be described.

Building Lay-Out

TI's new Central Research Laboratories Building was designed to house top calibre scientific personnel, together with the complex array of services and equipment required for TI's extensive research programs. To provide an atmosphere conducive to creative thinking, the building affords the occupants bright unimpeded working spaces with a pleasant outlook to grass, trees, and shrubs, as shown in Fig. 1. The building is constructed in three levels on a sloping site and is so arranged that the roof of the lowest level lines up with the floor of the next higher level and so on.

Each level is divided into three sections or wings and at the section junctions the levels are linked by stair bridges which also contain rest rooms, snack bars, and other employee convenience facilities. The areas between levels provide courtyards attractively landscaped.

The typical laboratory wing construction consists of a full basement, a reinforced concrete flat slab floor, a reinforced concrete flat slab roof and a curtain wall with an insulated sandwich construction wainscot high and dual wall glass glazing above to the roof line. The basement houses maintenance shops, model shops, stock rooms, and storage areas.

High Space Loads At Random Positions

A basic requirement for the air-conditioning system was that high space loads were to be expected at random positions in the building. The fulfillment of this requirement involved a high degree of individual temperature control combined with the ability to deal with unusually high space loads wherever they occurred.

Careful analysis of anticipated requirements, combined with a margin for future load increases, indicated that the average space load for the entire building would be 12 watts per square foot. In addition to this average loading, it was calculated that one-third of the building area might have an additional space load of 6 watts per square foot, making a total of 18. Finally, it was reckoned that certain areas might have a space loading of 24 watts per square foot.

Since it was not known at the time of designing where the high loads would occur, and even if their locations were known, they would not necessarily be permanent, it was evident that a great deal of flexibility had to be built into the air distribution system so that abnormal loads could be picked up wherever they appeared, without resorting to uneconomical oversizing of ducts or pipes.

The physical layout of the building contributed its influence on the air distribution possibilities. The cross-section of each level was arranged to provide rooms 12 ft. deep on the south side, a 7 ft. wide corridor, and rooms 24 ft. deep on the north side. It was desired to confine air distribution to the corridor, and the usual headroom limitation left a total section of 7 ft. by 2 ft. 4 in. to accommodate air distribution, sprinkler mains, electrical conduits, and lighting fixtures.

Exhaust Requirements

A further major factor influencing air distribution was the exhaust requirement. Work to be performed in the building involved the presence of a great variety of corrosive and toxic fluids and gases. It was evident that exhaust facilities had to be obtainable anywhere in the building to deal with laboratory fume hoods or experimental processes. Since even fresh air ventilated hoods typically require 50 percent room air for safe and stable operation, and their locations were indeterminate, the air distribution system had to cope with this condition as well as with the highly variable space loads.

The heat gains and losses for the building were worked out in the usual manner based on space conditions of 75F dry bulb and 50 percent relative humidity, with outside conditions of 95F dry bulb and 78F wet bulb in summer. Winter design conditions were taken as 10F dry bulb.

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The required supply air quantity was determined, based on the "minimum" condition of office-type occupancy (transmission, solar, lights and people loads only). A second supply air quantity was found for the "maximum" load condition ("minimum," plus highest average space load). These two figures were in the ratio of 1 to 1.7, and showed the variation in air quantity which might appear at the fans. The corresponding variation in fan static pressure was noted since it would affect the control of air distribution.

The combined requirements of all-over individual temperature control and highly variable space loads greatly reduced the possible methods of designing the air system. Maintenance considerations were unfavorable to a multiplicity of fans and coils, and architectural considerations were against any equipment being located in the occupied spaces, either at windows or overhead since no false ceiling was to be constructed.

Fig. 2: Fluctuating air requirements and need to exhaust toxic laboratory fumes required air throttling unit to keep Btu loss out of laboratory hoods at a minimum.

Temperature Control Requirement Solution

A dual duct system offered a straightforward solution to the temperature control requirement, but could take care of large load variations only if it were substantially oversized. The solution finally adopted is believed to be unique, so it will be described in some detail.

The cooling load per unit length with its built-in variation to pick up high space loads is handled by a form of throttling control, the delivered air quantity being capable of adjustment between the minimum and maximum values previously mentioned. This throttling control of cold air is combined with control of hot air by a special type of air mixing and noise attenuator unit.

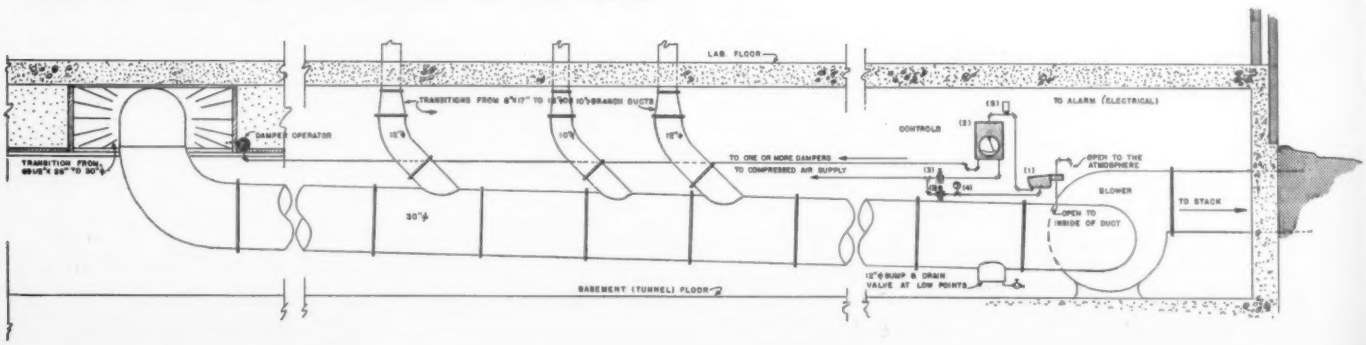
The units are arranged to have two separate pneumatic motors, one controlling a valve on the cold inlet, the other controlling the hot inlet. Pressure sensing pickups across a calibrated orifice along with a pressure regulator provide a control signal proportional to the delivered air quantity. A space thermostat controls the cold valve only, while the pressure regulator controls the hot valve. This is the opposite way round from the typical two-motor control set-up.

Control action is as follows – the pressure regulator, or flow controller, is set to control at the minimum cooling air quantity. This means that so long as the space load does not exceed the minimum value, hot and cold air will be mixed to provide a supply temperature which will satisfy the space thermostat. Also, the supply air quantity will be maintained on a constant volume basis.

If the space cooling load is increased above the minimum value, the flow controller becomes inoperative, since it can do no more than close the hot valve completely. The space thermostat will call for more cold air and will open the cold valve further.

Additional cold air will be available up to the maximum quantity since this is the basis of the duct design and of the fan selection. If all the mixing units are not demanding maximum air quantity simultaneously, and this is probable, even more than the "maximum" air quantity will be delivered, the limit being set by pressure losses resulting from increased flow.

Fig. 3: Below, fume exhaust system located in the basement, requires careful attention to tight joints.



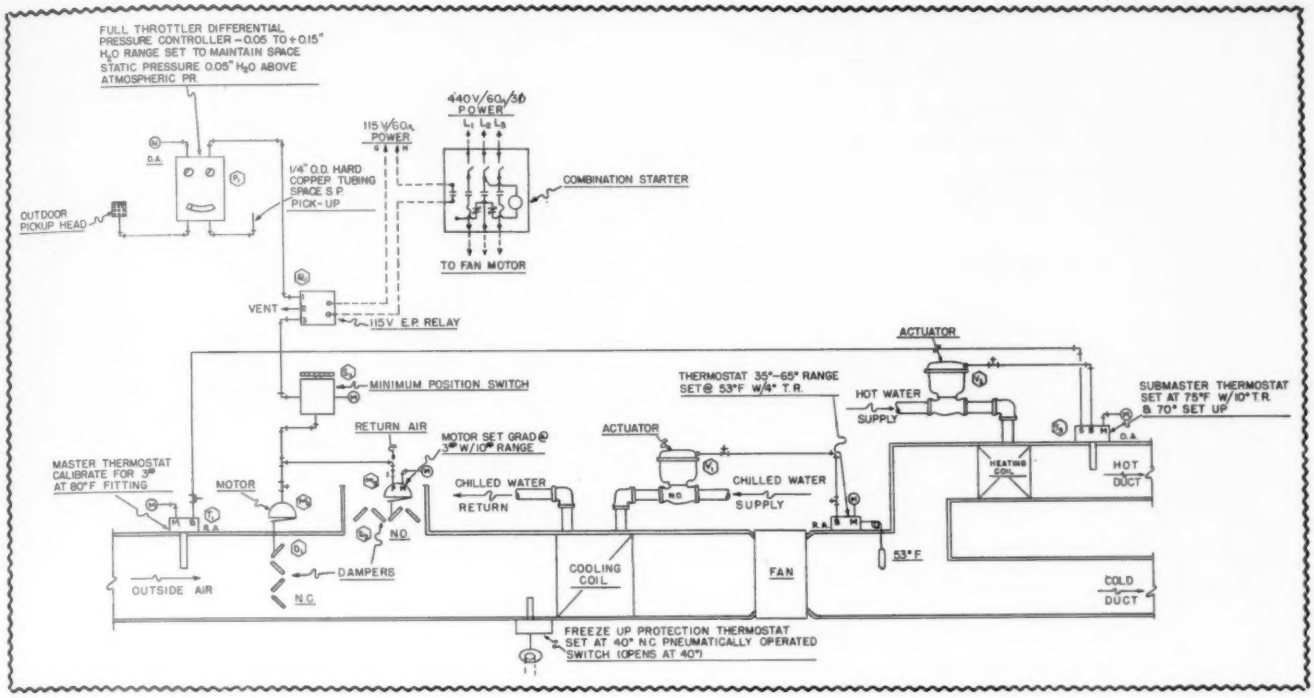


Fig. 4: Control system for over-all individual room control and highly variable space loads. See text for details.

To give specific numbers, a mixing unit which gives constant volume at 540 cfm is capable of supplying 1080 cfm under maximum cooling conditions. As applied to this building, these figures represent 15 and 30 air changes per hour respectively. It will be seen that even the minimum value means quite a high air circulation rate. This is not surprising since the minimum for this building corresponds with the maximum for regular office-type occupancy.

Space Noise Level

The change in air delivery between high and low space load conditions involves a change in space noise level. It was arranged that the high delivery would result in an acceptable level, while the normal delivery, covering most of the building, gave around 43 db A.

Duct design was based on static regain principles to minimize pressure variations in the duct system and to permit higher air quantities to be delivered to the far ends of duct runs when required. Initial air velocities leaving the fan discharge plenum are between 3,500 and 4,000 fpm.

The hot duct, with similar initial air velocities, is one-half the area of the cold duct. Full heating is accomplished by a 50/50 mixture of cold and hot air with a mixed supply temperature of 96F.

The main air supply to the building is handled by six main equipment units, each capable of delivering approximately 28,000 cfm. These units are located in basements adjacent to the bridges between levels. The resulting main supply duct sizes are such that a package of ducts and mixing units can be accommodated in the corridor ceilings.

Since space was limited, it was necessary to arrange for mixing units to fasten directly to the under-

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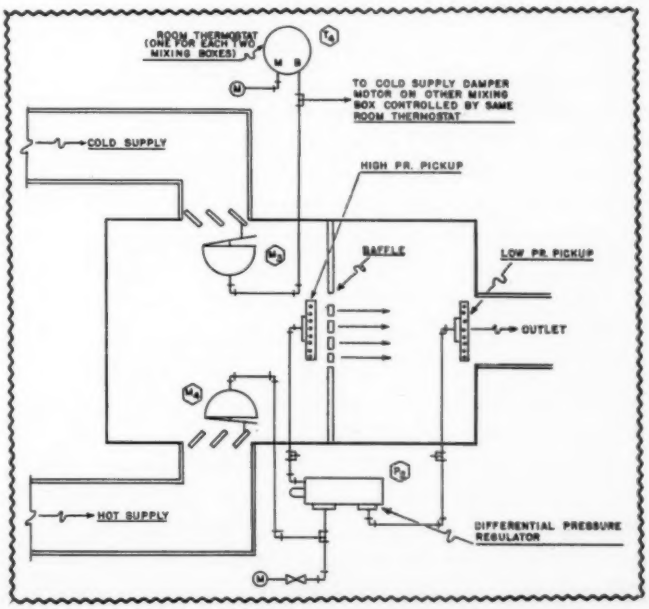
ROOM THERMOSTAT (ONE FOR EACH TWO MIXING BOXES)
TO COLD SUPPLY DAMPER MOTOR ON OTHER MIXING BOX CONTROLLED BY SAME ROOM THERMOSTAT
COLD SUPPLY
HIGH PR. PICKUP
BAFFLE
LOW PR. PICKUP
OUTLET
HOT SUPPLY
DIFFERENTIAL PRESSURE REGULATOR

Fig. 5: Right, hot duct reset schedule. Full heating is accomplished by a 50/50 mixture of cold and hot air with mixed supply air temperature of 96°F.

(Continued from preceding page)

sides of the hot and cold ducts. Sheet metal connections with vanes are used to make connection between the ducts and the mixing unit inlets. This made it easier to install the mixing units and also avoided unpredictable pressure losses which might have occurred if flexible hose had been used with a succession of tight turns.

Discharge air from mixing units is carried in low velocity ducts to slots in the corridor partitions. The slots are selected to deliver the low air quantity without cascading. Mixing units and slots are arranged on a modular pattern to permit maximum flexibility in partition location.

Return air from controlled spaces passes through louvers adjacent to doors into the corridor. From the corridor, it passes through louvers in false columns to the basement which is used as a return air plenum.

To minimize infiltration of unfiltered and untreated air, the building as a whole is maintained at a slight (0.02 in. w.g.) positive pressure above atmosphere. This is achieved by static pressure controllers which position fresh and return air dampers to increase the intake of fresh air when the building pressure tends to fall. A modulating control was required here because the number of exhaust hoods in use would not be constant.

Manifold Exhaust Systems

The exhaust problem for the building was rather complex. As mentioned earlier, exhaust might be required anywhere in the building and although the exhaust air quantity could be assessed, its location could not. A modular pattern of knockouts was provided in the floors and roofs. Roof knockouts permit the introduction of outside air to ventilated hoods where required. Weatherproof intakes are located on the roof openings and small fans draw air from them and supply it to hoods. The floor knockouts permit exhaust air to be led to the basement where it connects to an exhaust manifold.

Six manifold exhaust systems are installed in basement areas, each capable of handling 15,000 cfm. A typical system has an air intake near the center of a building level and a circular duct of constant size (30 in. diameter) runs from this intake to the suction side of a fan located near an end building wall. The fan discharges its air through a short tunnel which leads beyond the end wall to a circular vertical stack pipe extended higher than the roof. Connection taps, blanked off where not presently required, are provided at intervals along the manifold, so that an exhaust service involves only the installation of a short duct up through a floor knockout.

The air intake and manifold duct are sized to handle the full fan air quantity. A static pressure controller with its sensing pickup located near the fan suction operates a damper behind the fresh air intake. The purpose of this arrangement is to maintain a constant air quantity through the fan regardless of how many exhaust hoods are connected or being operated. If few hoods are connected, the fresh air quantity will be high, and vice-versa.

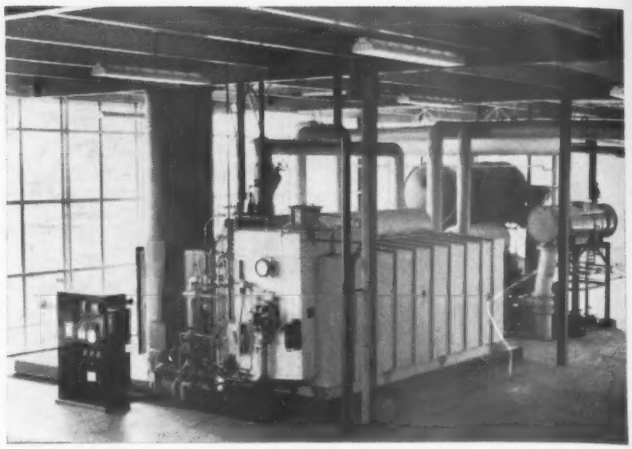

Fig. 6: Part of heating and air conditioning equipment in TI's new 23,200 sq. ft. central utilities building. Foreground, steam boiler. Background is a 3,000-ton capacity turbine driven centrifugal cooling compressor system.

Also, the discharge air velocity at the exhaust stack remains constant at 4,000 fpm to carry fumes high above roof level and to provide ample dispersal and dilution.

The hood exhaust air quantity is limited to 12,000 cfm so that there will never be less than 3,000 cfm of air in any part of the manifold. This keeps the manifold clear of any gases of relatively high density which might otherwise tend to lie on the bottom surface. The entire exhaust system, including the fan, is coated internally with a coating which protects it against attack by corrosive gases.

The main air handling units are constructed of masonry casings which accommodate filters, coils, and fans. The arrangement is straightforward.

Return air motorized dampers are mounted on top of the unit inlet plenum, and a metal fresh air duct also connects to this plenum. Mixed air is drawn through cleanable type filters, then through a cooling coil with eliminators to the suction side of a double-inlet centrifugal fan. The fan discharges through an expander to a plenum section which constitutes the cold deck. An insulated horizontal divider, above which is mounted a bank of heating coils, makes a hot deck. The location of the heating coils and the back-tracking airflow path through them eliminate the danger of cold air being heated above its desired temperature, due to scrubbing action and proximity effects.

The fresh air duct leads from an architectural intake louver through motorized dampers controlled by building static pressure as previously mentioned. Preheat coils with face and bypass dampers are fitted between the intake and the unit suction plenum.

(Please turn to page 44)

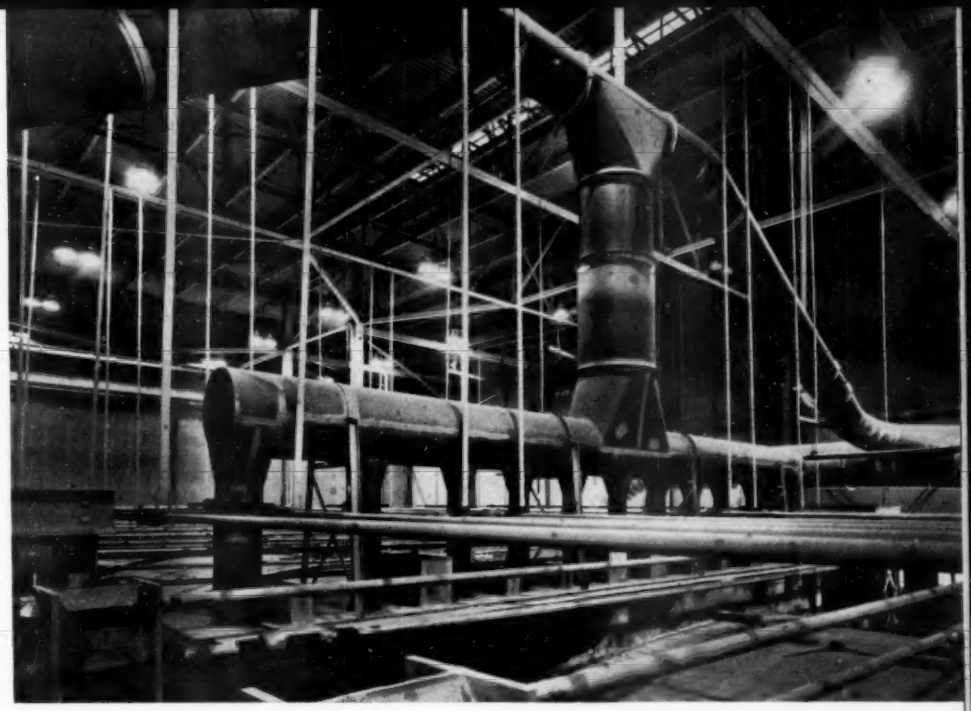

Fig. 1: Right, pressurized, suspended curtain wall cooling system for glass furnace, located between the melter and refiner glass furnace sections.

by W. T. Fleming
The Kirk & Blum Mfg. Co.

Air Systems In The Glass Industry

How to stretch life of glass moulds and glass furnaces, boost production of glass products, reduce temperature defects, by proper design of furnace cooling systems . . . combustion air distribution . . . abrasive dust collection.

DURING the last two decades the glass industry has experienced phenominal progress in the extension of furnace life. Campaigns have been extended from one or one and one-half years to as long as six years, with corresponding increases of tonnage per year. This progress is attributed to improved structural design, improved furnace refractory and improved refractory cooling systems.

Air cooling by impingement onto the refractory surfaces is utilized to reduce the refractory temperature, thereby retarding corrosion and abrasion of the surfaces in contact with the molten glass or surfaces exposed to direct flame and products of combustion or to chemical action of the batch compounds.

Cooling air applications will vary with furnace design, refractories used and type of glass product, however, consideration is given to cooling the following zones on all furnaces:

¶ Melter and refiner refractory walls at glass line.
¶ Port jambs, connection arches and skew beams (Fig. 2).
¶ Throat or suspended curtain wall between melter and refiner sections (Fig. 1).
¶ Doghouse offset corners.
¶ Bottom blocks.
¶ Crown blocks.
¶ Capped capacity for future spot cooling.

Fans are selected for pressures ranging from 4½ in. to 6 in. water column "fan static pressure," depending on ductwork layout and losses, to produce a minimum discharge velocity pressure of 4 in. water column or 8000 fpm at standard air conditions at discharge nozzles. Normal fan recommendations are Arrangement III, with independent bearing pedestals, and Class III construction due to the uninterrupted operation requirements for a period up to six years.

Air volumes will vary with the type and size of the furnace and with the peculiarities of furnace design and operating procedures.

Assuming a fan static efficiency of 80 percent for an "airfoil" non-overloading impeller, and a fan static pressure requirement of 5½ in. water column, shaft horsepower per 1000 scfm would be 1.086, and the cost per year per 1000 scfm would be $83.10 based on a 1¢ per

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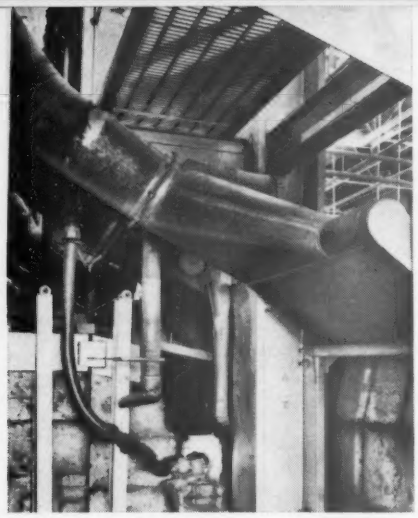

Fig. 2: Photo shows skew beam and port jamb cooling system for glass furnace in a large plate glass factory.

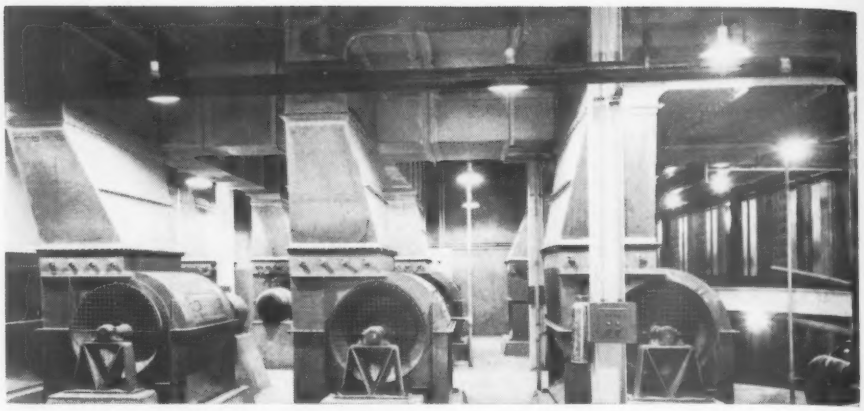

Fig. 3: Typical fan manifolding for air cooling supply for glass furnaces. Fans are selected for pressures up to 6 in. w.g. or 8000 fpm, at standard air conditions for discharge velocity pressure of 4 in. w.g. at air nozzles.

(Continued from preceding page)

kwhr rate. Total power cost for air application per furnace should consider rate of air application, assuming the furnace operator will not apply full air volume available until he is 50 to 75 percent through a campaign.

Estimated costs covering design, fabrication, delivery, and installation of a furnace cooling system, complete with fans and motors, will vary from about $450.00 per 1000 scfm on a large plate glass furnace to about $370.00 per 1000 scfm on a container furnace. These estimates vary greatly with furnace design and equipment layout.

One fallacy that exists in the minds of most furnace operators is the heat loss attributed to cooling air. Actual heat loss in percentage of total input amounts to about 6 percent while the natural radiation and convection losses of areas other than those being cooled amounts to 45 percent.

Combustion Air Systems

Oxygen is furnished for combustion, in gas and oil fired furnaces, as a component part of air. Requirements vary greatly with furnace design, fuel, heat losses, etc. Modern installations incorporate the use of preheated combustion air (Fig. 5) to improve overall efficiency and to maintain a more uniform control, eliminating corrections for variations in atmospheric temperature. Preheated air is obtained from over the furnace, utilizing heat that would be lost thru gravity roof ventilators.

Glass container or tableware production has increased, with the advent of automatic glass forming machinery, from 45 to 105 gross per 24 hours per man (by hand) to 250 to 1500 gross per 24 hours per man. These general averages cover the full range of container capacity and size.

"Press" and "blow" glass forming moulds are cooled by direct impingement of high velocity air to enable increased glass production by decreasing the time required for the glass to become firm enough to retain its shape during handling and transfer. Another advantage of air cooling is the elimination of "hot side" temperature defects such as tears resulting from glass sticking to the mould.

Air volumes and pressures vary with machine type and maximum ware weight. Current design volumes range from 12,600 scfm on each small rotating table machine to 21,000 scfm on each large sectional type machine. Fan static pressure selections vary from 14 in. to 21 in. water column.

Dust Control

The glass industry, as other basic industries, have dust problems inherent in their processes. Unloading, storage, blending and mixing of batch ingredients generate dust that is high in silica conten. Cullet crushing conveying and storage operations produce some dust particles less than 5 microns in size.

Unusual care must be exercised in the design and installation of equipment enclosures, low velocity hoods and exhaust equipment, to keep batch loss at an absolute minimum, particularly for the trace materials.

Due to the highly abrasive nature of collected dust, the system specifications must be written for unusually heavy wall elbows and wear sections. U.S. Standard #12 gauge elbows have been known to wear out in 30 days of operation, for example.

Consideration must be given to hydroscopic materials such as soda ash to prevent branch line plug-up. In most cases continual maintenance of these branch lines is required to maintain dust control.

Enclosures and hooding for blending scales must be arranged so that the negative pressure will not affect the accuracy of the scales.

Batch house dust collection units (Fig. 6) are usually tube type cloth filters for intermittent duty. Air foil bladed high efficiency fans are selected for "draw thru" installation.

(Please turn to page 45)

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Fig. 7: Left, piping and hoods for reversing shuttle conveyor, stationary conveyor and bins, glass making.

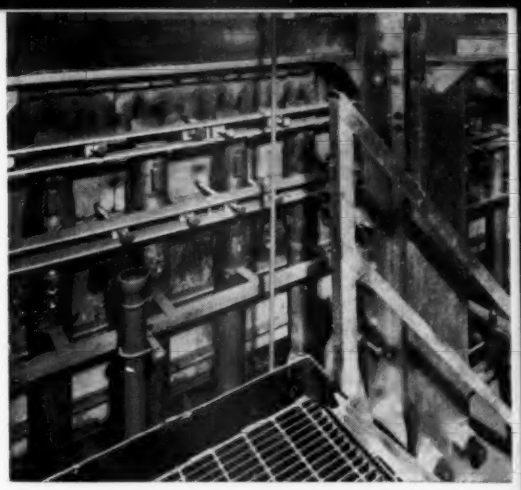


Fig. 4: Cast aluminum sidewall nozzle with adjustable orifice control for glass melting furnace cooling.

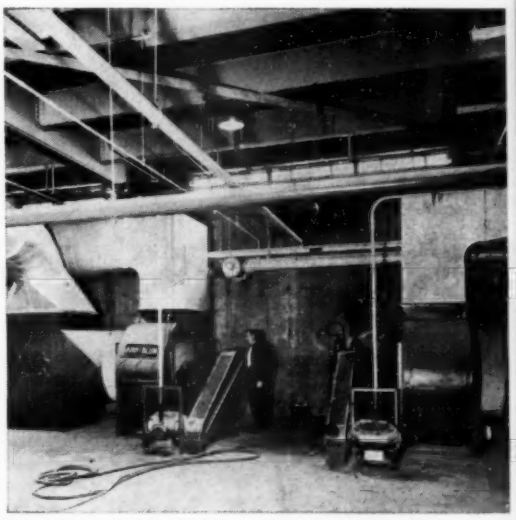


Fig. 5: Two combustion air fans for two independent furnaces. Pre-heated air enters the top of mixing chamber. Automatic controls are provided to maintain uniform temperatures for proper combustion, better efficiency.

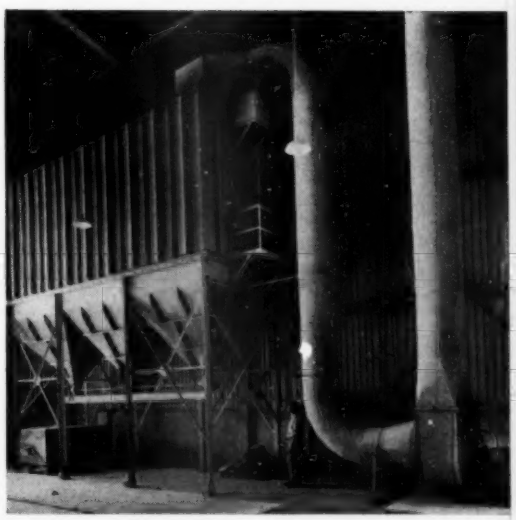


Fig. 6: Multi-bag filter with rotary air locks on dust hoppers. Fan was selected for 14 in. static pressure.

AIR VOLUMES FOR FURNACE COOLING

TYPE OF FURNACE	MAXIMUM AIR VOLUME	MOTOR HP PER FURNACE
Plate Glass	384,000 cfm	Six 75 hp
Sheet Glass	252,000 cfm	Six 50 hp
Container	97,000 cfm	Two 60 hp
Tube	38,000 cfm	One 50 hp

New Literature

To receive information on the New Literature, circle the item reference number on the postage-free reply cards on page 37.

Ventilating Flow Instruments

Bulletin on Davis Ventilating Flow Instruments has been published by Epic, Inc. Instruments cover ranges from 30 ft./min. to 6000 ft./min.

Circle #131 on page 37.

Equipment For Process Industries

Major product lines for the chemical processing industries are described in a new 12-page bulletin offered by the Fuller Co.

Circle #132 on page 37.

New Control Manual

"Automatic Control Of Heating And Air Conditioning" is the title of a new 375 page book by John E. Haines, vice president, Minneapolis-Honeywell Regulator Company, published by McGraw-Hill Book Company. Book illustrates and details specific applications in heating, ventilation, refrigeration and air conditioning.

Circle #133 on page 37.

Absorption Cycle Refrigeration Study

A new study of the relationship between chemical structure and efficiency of the absorption-refrigeration cycle has been completed by the American Gas Association.

Priced at $1.50 each.

Circle #134 on page 37.

Packaged Electronic Air Filter

Bulletin No. 258B gives complete engineering data on American Air Filter Company's new line of completely self-contained, high velocity electrostatic precipitators. Called Type HVSC Electro-Cell, the new air filter is designed for use in inaccessible areas and for use with air handling units. Unit comes in 24 sizes, from 1000 to 25,000 cfm.

Circle #135 on page 37.

High Intensity Infrared Equipment

From Fostoria Corp. a new brochure descriptive of new techniques, using fluid cooling, making possible compact quartz lamp ovens and furnaces with high heat transfer.

Circle #136 on page 37.

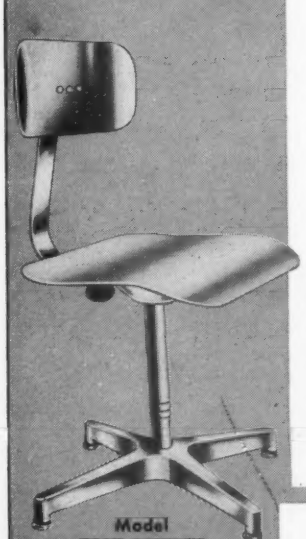
Multi-Drive Piping Manual

This 34-page manual issued by Brunner Div. of Dunham-Bush tells how to multi-plex refrigeration compressors (parallel compressors). Chapters include pipe sizing, arrangement of liquid, suction and discharge lines, head pressure control, crankcase oil control and hot gas defrost connection.

Circle #137 on page 37.

(Please turn to page 38)

SPECIAL CHAIRS FOR WHITE ROOMS AND DUST FREE AREAS



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- All Chrome Plate Finish
- Easily Cleaned
- 12 Ga. All-Steel Seat; 14" x 15⅜"— Waterfall Form. Sand Blast Surface. Adjusts 18" to 26".
- 12 Ga. Steel Backrest; 6" x 13¾"—with tempered steel backrest support. 6 inch horizontal adjustment. Backrest folds down to make easy cleaning.
- Cast Iron Base; 20-inch spread. 1⅛" steel glides.

Other White Room chairs with lacquered plywood seat and backrest.

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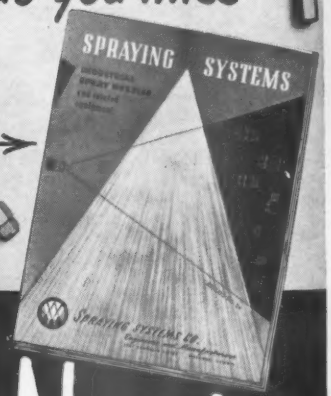
AJUSTO EQUIPMENT CO.
Bowling Green, Ohio

[For more information circle #28 on page 37 reply cards]

how much do you miss without this?



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[For more information circle #29 on page 37 reply cards]

New PRODUCTS

To receive information on any of the New Products, circle the item reference number on the postage-free reply cards on page 37, Communications Center.

White Room Clothing Drycleaning And Laundry Equipment

Purpose: Hoffman International announces the introduction of systems designed for total cleaning of white room clothing and accessories. Microscopic examination of white room garments has shown that conventional dry cleaning and laundry equipment is inadequate to meet rigid standards of cleanliness.

Features: Among the Hoffman machines especially designed to protect white rooms from contaminated clothing are the Master Jet, the Vaposaver and the Absorber. The Master Jet dry cleaning machine shown above has been engineered to provide continuous filtration of cleaning solvents during the cleansing operation and absolute filtered air during the drying cycle so that all uniforms, laboratory coats and accessories are completely free of lint and other microscopic contaminants. The Vaposaver unit, incorporating Hoffman's exclusive, absolute filtered air process, insures truly clean drying and deodorizing. The Absorber serves to eliminate solvent odors. All three units combine to provide complete freedom from white room clothing contamination.

Circle #71 on page 37.

Compact Water Chillers

Purpose: Two new chillers for multi-room building and industrial process applications, introduced by Typhoon Heat Pump Division, Hupp Corp.

Features: Capacities of 17 and 25 tons, factory assembled, piped, wired, tested, and shipped with holding charge of Refrigerant-22.

Unit uses approximately 8 sq ft of floor space and is slightly more than four ft high.

Circle #72 on page 37.

School Unit Ventilators

Purpose: Heating, natural cooling and ventilation in new school or school remodeling projects.

Features: Edwin L. Wiegand Co. "Chromalox" NU series units offer air capacities from 600 to 1,500 cfm. Motors operate at three speeds. Models in varying lengths, according to cfm air and kw heating capacity.

Circle #73 on page 37.

High-Rise Building Incinerator

Purpose: According to Joseph Goder Incinerators, a custom-designed installed incinerator and rubbish chute system recommended by the city of Chicago for all high-rise buildings.

Features: Under each disposal chute is portable cart. At certain intervals cart is manually wheeled to incinerator, and is hooked to lift that automatically raises and tilts it to dump position.

The two chamber incinerator has burning capacity of 1200 lbs per hour, disposing of 8400 lbs of refuse a day.

Circle #74 on page 37.

(Please turn to following page)

in laying out your client's plant

ARE YOU GUARDING AGAINST DUST DAMAGE TO MACHINES?

Will there be dust-producing machines in your client's new plant? Such as metalworking, wood-working or penumatic conveying equipment? If so, you should plan now for dust control.

Because dust clogs and gums up costly machinery, lowers production efficiency, causes breakdowns and higher maintenance costs. In addition, dust is harmful to the health of employees.

More and more professional men, laying out new plants and remodeling older ones, are specifying Torit Dust Collectors. Torit Dust Collectors have proved 98% efficient in removing dust. They are compact, easy to install and maintain, and cost far less than many types of dust collecting equipment.

Contact a Torit representative. He will give you dust collector specifications, performance charts, dimensional drawings, installation suggestions . . . all the information you need.

Write:

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MANUFACTURING COMPANY

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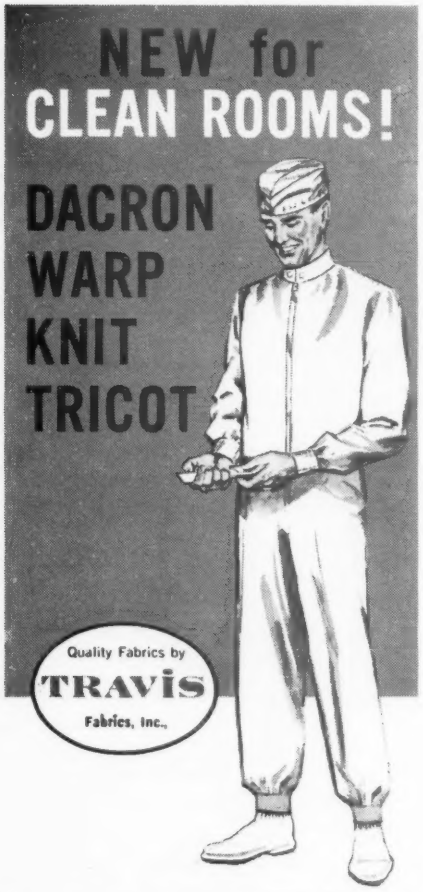
Cyclone model. *Also available in portable cabinet models.*

[For more information circle #30 on page 37]



Here is an entirely different fabric of 60% Dacron and 40% Nylon, now introduced in industrial apparel specifically for **CLEAN ROOMS. Lint-Free Tricot** is lightweight, yet opaque... offers greater comfort because this unique fabric actually permits the garment to breathe. Unusual serviceability too! Will not ravel if torn or snagged. Special wrinkle-resistant finish retains its shape better, looks neat longer.

Look for new fabrics, new styles, new colors from Worklon, leader in the manufacture of special purpose work clothing. Choose from America's largest selection of lint-free, static-free and acid-resistant industrial apparel ...all illustrated in Worklon's new 1961 Fall Catalog.

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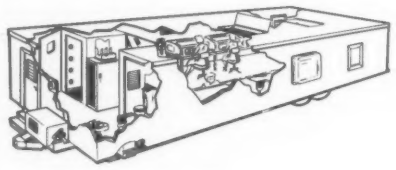
[Circle #31 on page 37]

New PRODUCTS

Economical, Mobile, Packaged Clean Room

Purpose: For small companies to use in critical assembly work without the necessity of a high capital expenditure. The entire "Clean Room" is manufactured and delivered by Controlled Atmosphere Enclosures Mfg. Co. complete and ready for operation.



Features: Packaged mobile 500 sq. ft. "Clean Room" complete with "absolute" filtration, humidity and temperature controlled air conditioning, air shower, flush lighting, interlock, toilet facilities, dressing room, vinyl walls and floor. Special facilities or "Clean Room" components, such as shoe cleaners, vacuum cleaners, dust counters, sticky-mats, fume hoods or "sterilhoods" can be provided and factory installed. Air filters and replacement lighting bulbs are changed on the outside. The "Clean Room" area can be expanded at any time, even during productive hours, by the attaching of additional mobile "Clean Room" units. A specially designed connecting interlock-door, will allow the continuous adding of "Clean Room" space, each with their own independently controlled air handling system.

Circle #75 on page 37.

60 Inch Vaneaxial Blower

Purpose: For general ventilation, air moving.

Features: A 60-in. diameter belt-drive vaneaxial blower has been added to the line of vaneaxial blowers manufactured by the Hartzell Propeller Fan Company.

The new unit will move 96,450 cfm at 2 in. sp (98.3 bhp) or 66,500 cfm at 7 in. sp (116.7 bhp).

The Hartzell vaneaxial blower line now includes belt-driven models in eleven sizes—12 in. to 60 in.—and direct drive models in six sizes —18 in. to 42 in.

Construction features common to all models include precision finished cast aluminum-alloy impellers and all welded construction, with guide vanes welded to both inner and outer shells.

Circle #76 on page 37.

Dust Collector With Suction Booth

Purpose: From Torit Manufacturing Co. for specialized cleaning applications in food, chemical, and pharmaceutical processing operations, as small products being freed of dust particles before packaging.

Features: Combination of Model 75 cabinet cloth filter dust collector and top-mounted cleaning booth. Removable stainless steel screen forms bottom of booth, walls are white enamel, opening in top retains air hose to facilitate cleaning.

Unit contains 120 sq ft of cloth filter area. One hp motor and blower moves up to 550 cfm of air through 4 in. top inlet. Dust storage drawer is 780 cu in. Cabinet is 22 in. wide, 25 in. deep and 44 in. high.

Circle #77 on page 37.

Fluid Filtration Test Kit

Purpose: For checking contamination of liquids down to 0.25 microns.

Features: Designed for lab work in ultra-fine filtration, can be used wherever lube applications require high degree of contamination control as in servo system bearings, gyros and tape transports.

Bearing Inspection, Inc., Fluid Filtration Kit, Model SI-13, kit consists of a 10 cc, precision-ground, glass syringe, with a special adapter and 25 membrane filters, which provide effective removal of particles down to 0.25 microns. Fluid volume can be directly measured to 1/10 cc. The filters readily lend themselves to easy microscopic

inspection. One 23-gauge ½ in. needle is supplied, other sizes are available if desired.

Circle #78 on page 37.

Centrifugal Roof Ventilator

Purpose: Ventilating public buildings, exhausting gases and fumes from factories, laboratories, foundries, and other industrial buildings. From American-Standard Industrial Division.

Features: Model CRD line is made in eight wheel sizes with capacities from 194 to 2788 cfm. Fan wheel is fabricated of aluminum, backwardly inclined, and non-overloading. Blades are die-formed, mounted between heavy-duty backplate and die-formed rim. Deep-spun inlet designed to introduce exhaust air to wheel with minimum turbulence. Fan wheel housing of aluminum and motor hood of spun aluminum.

Circle #79 on page 37.

Large Part Ultrasonic Cleaner

Purpose: Reduce cleaning time of large parts up to 50 percent.

Features: Acoustica Associates large ultrasonic cleaning system uses new, fully-transistorized generator delivering 25,000 watts to two 500-gal. cleaning tanks.

Contains recirculator which completely pumps, filters and heats liquid in either tank before liquid re-enters tank on return cycle. Recirculator has replaceable filter cartridges in a range of from 1 to 50 microns, and automatic indication of filter replacement need.

Circle #80 on page 37.

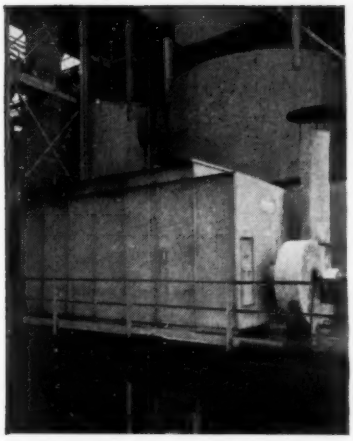
Filter-Type Return Air Grille

Purpose: For installations where heating and cooling systems are located in inaccessible spots.

Features: Termed the 18FG Series from the Lima Register Co., the grille is hinged at the base with a full-length piano hinge and has a frame and filter rack allowing a 1 in. filter to be installed directly behind the grille.

Grilles are produced in a complete range of sizes to handle 500 to 2000 cfm.

Circle #81 on page 37.



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[For more information circle #32 on page 37]

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[For more information circle #33 on page 37]

AIR DECONTAMINATION IMPORTANT STEP IN ASEPTIC PROCEDURES FOR "WHITE ROOMS"

*

Effectiveness, safety and ease of installation keynote the scientific (functional) designs of new Letheray germicidal fixtures. They represent the culmination of 25 years scientific development and manufacturing experience in the field of air sanitation equipment by Hanovia, the name synonymous with ultraviolet for more than 50 years.

*

Protects humans, products and laboratory animals against air-borne infectious diseases and contamination.

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UNIVERSAL MODEL: Direct or focused irradiation. Continuous or intermittent operation.

*

MOBILE UNITS: Hospital Model, 65 Watts; Industrial Model, 1200 Watts.

AIR DUCT STERILIZERS: High intensity 1200 Watt Sterilizers for exhaust and air conditioning systems.

*

SAFEGUARDS Sterile Processing, Packaging and Research Areas; Cubicles; Air-locks; Hoods; Animal Rooms; Hospital Operating Rooms, Isolation and Autopsy Rooms, Wards and Clinics.

*

Other famous Hanovia Ultraviolet products include: Black Light and Analytic Lamps, Water Sterilizers, Photochemical Equipment (laboratory and commercial), Light Sources for Instrumentation.

*

Write for information on ultraviolet lamps and related equipment.

Special Products Dept.

★ ENGELHARD HANOVIA, INC ★

HANOVIA

LAMP DIVISION

100 Chestnut Street, Newark, New Jersey

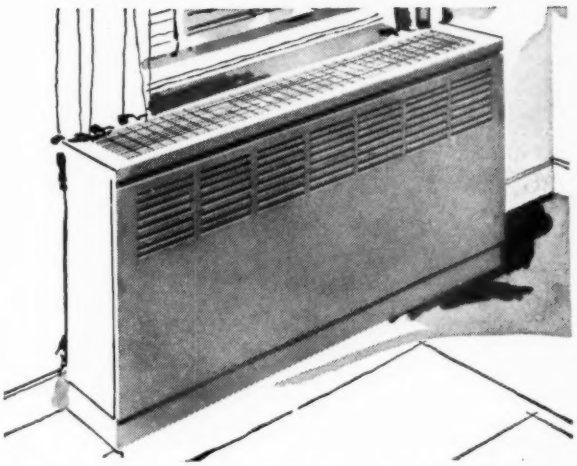
[For more information circle #34 on page 37]

NEW CARRIER REHEAT WEATHERMASTER SYSTEM

...WHERE and WHY you can use it to advantage!

Now you can capitalize more often on the unique advantages inherent in all single duct, constant volume air conditioning systems with reheat at room terminals. The new Carrier 36BA Reheat Weathermasters* permit use of either high or normal velocity primary air. Four reheat coils are now available in each unit size. And you have a wide selection of new modular cabinets and furred-in arrangements.

You can select units more economically to meet cooling capacity and sound control requirements, with the assurance that they will also be able to match almost any heating load —regardless of geographical location, exterior glass area, or limitations of existing steam or hot water plants. For complete information on the new Carrier Reheat Weathermasters,



write for the 8-page catalog, 36BA86. Carrier Air Conditioning Company, Syracuse 1, N. Y.

WHERE:

Existing office buildings, hospitals and hotels, regardless of size, where present steam and hot water services are in good condition. Units replace radiators; only supply air duct system need be added.

Schools, where high ventilation capacity and ease of automatic room temperature control make this system very suitable. May be applied for heating and ventilating only, with cooling added later at low cost.

Laboratories, where precise control of both humidity and temperature is a requirement.

New small office buildings, where it is usually impractical to apply a high-pressure induction system, yet a quality system at low cost is wanted.

WHY:

All-air cooling assures superior ventilation and odor dilution.

Induction at unit permits smaller ducts, lower fan horsepower, gravity heat.

Constant volume supply air speeds system balancing, maintains constant air motion.

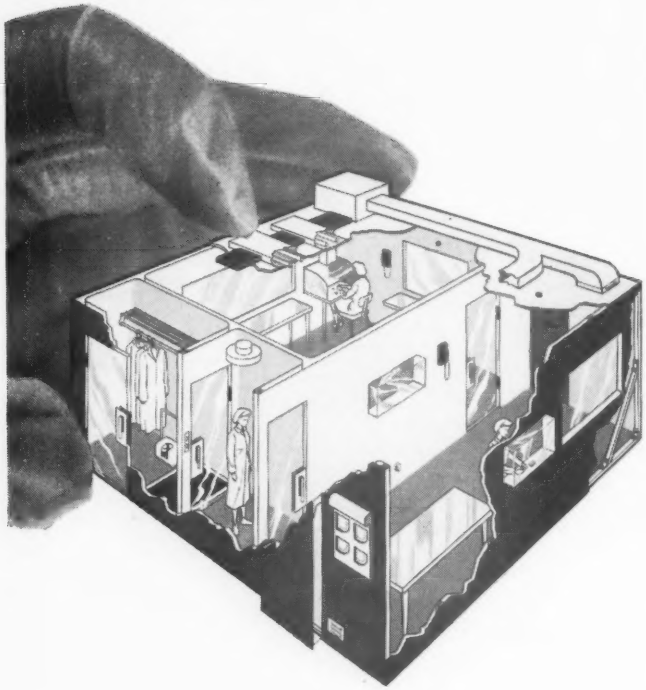
Constant temperature supply air simplifies central station apparatus, provides maximum humidity control.

Central station design eliminates service in occupied spaces.

Reheat at unit provides best possible control, solves zoning problems.

Carrier ***Air Conditioning Company***

[For more information circle #35 on page 37 reply cards]



COMPLETE CLEAN ROOMS

• DESIGNED • INSTALLED
• ONE PACKAGE • ONE PRICE

When you need super clean facilities for manufacturing, assembling or testing, investigate CE "Complete Clean Rooms" before you undertake to act as your own designer, engineer and general contractor.

The total cost of a CE installation is almost always less; you get assured performance to fit your specifications; you start operation on a fixed schedule; and you save executive and engineering time by dealing with one supplier.

Write for bulletin "Complete Clean Rooms" which outlines the scope of CE service and includes thirty-one constructional and operational details of a typical CE Clean Room.

Controlled Environment, Inc.
915 GREAT PLAIN AVENUE, NEEDHAM 92, MASSACHUSETTS

[For more information circle #36 on page 37]

Technological Complex

(Continued from page 32)

Acoustic linings are fitted in the fan suction and discharge sections of the unit housing. Tapered inlets are used between the discharge plenum and the (moderately) high velocity ducts to reduce the entry loss.

Control action is uncomplicated. The cold deck is maintained at 53F year round – in summer by modulating chilled water to the cooling coil, and in winter by modulating the face and bypass dampers on the preheat coil. Summer humidity is held at 50 percent or less by control of the supply air dew point. In winter, no humidification is added but the proportion of recirculated air is fairly high. The hot deck temperature is controlled in relation to outside temperature by a master-submaster arrangement which raises the hot deck control point as outside temperature falls. The hot deck is varied from 80F to 140F as the outside temperature falls from 100F to 0F.

Cooling for the building is provided by chilled water from a central station utilities building, the temperature range being 30F to 53F. The heating source is high temperature water from the central station, with a temperature range of 300F to 220F. This water also provides heat for domestic water. A heat exchanger is used with secondary circulation at 180F dropping to 140F for the preheat and reheat coils.

Btu meters are provided in the chilled and high temperature water systems to record heating and cooling usage for performance checking and for cost accounting purposes.

A few specific areas are not served by the twin duct high velocity system. These include a Cafeteria, Library, and a Conference Room which have conventional low velocity systems independent from the six main systems.

Next month, details on the air handling system at T-I's semi-conductor plant. ▲▲

EQUIPMENT

Absorption Refrigeration Compressors . . . *Carrier Corp.*
Packaged Steam Boilers . . . *Babcock & Wilcox Co.*
Air Handling Units . . . *The Trane Co.*
Filters . . . *American Air Filter Co., Inc.*
Fans and Blowers . . . *The Trane Co.*
Cooling Towers . . . *Pritchard & Co.*
Controls . . . *Minneapolis-Honeywell Regulator Co.*
Boiler Controls . . . *Bailey Meter Co.*
Pumps . . . *Allis-Chalmers.*
Air Mixing Units and Air Outlets . . . *Thermotank, Inc.*

CREDITS

Architects . . . *O'Neil Ford and Richard S. Colley, Corpus Christi, Texas and San Antonio, Texas.*
Consulting Engineers . . . *Air Conditioning and Engineering Associates, Inc., Detroit.*
Liaison For Owner . . . *R. S. Sloan, Facilities Director, Texas Instruments, Inc.*

How To Design Make-Up Air

(Continued from page 27)

duced effectively by the appliance regulators supplied with the furnaces. For line pressures over 8 oz., an additional pounds to oz. regulator can be supplied at extra cost. (Applied to all but LP gases.)

Properly selected, installed and controlled make-up air heating systems can end all of the evils attendant upon negative air conditions in your plant, and actually pay their own way in terms of lessened employee illness, time off and compensation claims . . . reduced fuel bills . . . better heating conditions for people and machines . . . cleaner air and reduced product contamination. ▲▲

Air Systems In The Glass Industry

(Continued from page 35)

Cullet dust control systems are equipped with high efficiency centrifugal collectors, due to the high percentage of dust particles over 5 microns in size. Material handling fans constructed for abrasive duty are installed for "blow thru" installation.

The abrasive nature of batch ingredients and their attendant wear problems on pipe and equipment and the health hazard of these ingredients, demands close attention to air systems in the glass industry, as outlined in this article. The points discussed cover the major problems of dust control and collection in the glass industry, and if followed will help assure a clean, healthful working environment that will prolong both human and machine life. ▲▲

Use the Communications Center, page 37, to receive more information about any product advertised, any new literature or new product described. Circle the number on the postage-free card that refers to the item of your interest, add your name and address and mail.

To comment or make suggestions about any article in this issue, use the Editorial comment card.

SPENCER Vacuum

Assembly and Gaging Dept., Miniature Precision Bearings, Inc., Keene, N. H.

KEEPS "WHITE ROOMS" WHITE

Dirt and dust are strictly bad news around gaging or assembly areas of a company producing precision ball bearings. Every possible precaution must be taken to assure an absolutely dust-free atmosphere in the "white rooms".

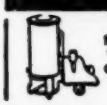
That's why, at plants like this modern Miniature Precision Bearings, Inc. factory, you'll find SPENCER vacuum cleaning systems providing *sure* sanitation.

Whether your cleanliness requirements are critical . . . or whether *convenience* and *economy* of maintenance are primary, you'll find a SPENCER system the answer to your needs.

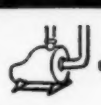
Write for complete information on SPENCER installed vacuum cleaning systems or request a piping layout to meet your particular requirements.

The SPENCER TURBINE COMPANY
HARTFORD 6, CONNECTICUT

OTHER QUALITY SPENCER PRODUCTS


PORTABLE VACUUM CLEANERS

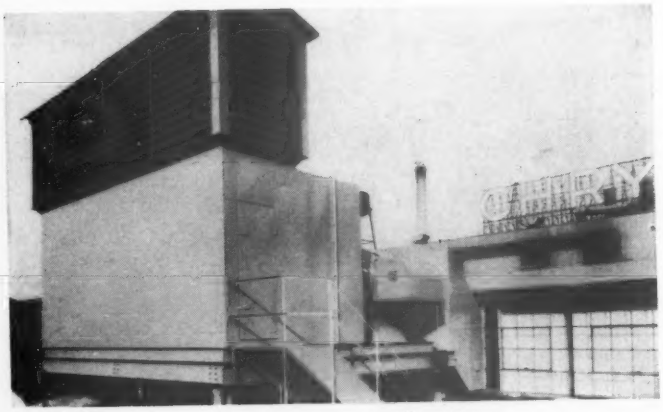
PNEUMATIC CONVEYING SYSTEMS

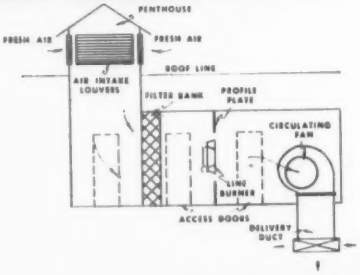

BLOWERS

[For more information circle #37 on page 37 reply cards]

exhaust systems removing dirts, fumes, vapors, and other contaminants create need for

CLEAN FRESH AIR





Dusts, fumes, vapors and other contaminants from process equipment must be replaced by clean, fresh, heated air. MAXON equipped "Make-up Air" Heating Systems are solving air replacement problems for plants, large and small, in all types of industry.

GET THE COMPLETE STORY. WRITE TODAY FOR BULLETIN AS-62 — See your MAXON Application Engineer.

MAXON PREMIX BURNER COMPANY
MUNCIE, INDIANA

MAXON

Ad No. 72

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RATES—Classified advertising is run in 6-point type (this size) under suitable headings. Minimum rate $5.00 for forty words or less. Extra words .15 each. Box addresses, with usual services, count as five words. Display type ads available. Payment required with order. No agency commission, no checking copies. Closing date first of month preceding month of issue. No proofs will be submitted prior to running, but proof will be forwarded for record. AIR ENGINEERING, 450 W. Fort Street, Detroit 26, Mich.

Reprints

To receive any of the Reprints, circle the item reference number on the postage-free reply cards on page 37.

Economics Of Factory Air Conditioning

New accounting methods to prove before buying and installing air conditioning, that the investment will pay off as well or better than any other piece of capital equipment. Price 75¢.

Circle #172 on page 37.

Special Report On White Rooms

Discusses White Rooms as a market, equipment and supplies used in White Rooms, and White Room marketing channels.

Circle #176 on page 37.

White Room Symposium Papers

Presented at American Institute of Plant Engineering Symposium on Dust Control, Tempe, Ariz., Nov., 1960. Price $5.00 (used for start of new American Assoc. For Contamination Control).

Circle #178 on page 37.

COMPLETE "PACKAGED" FUME SCRUBBER

...in Standard Sizes ...at Lower Cost

THE *Cyclonaire*

If your "white room" or plant is faced with annoying fume removal problems, the Cyclonaire may offer a most inexpensive answer.

This compact wet bed scrubber does a fume removal job that once was possible only with expensive custom units. Removal of many gases (of 1% concentration or less) is 99% effective.

The Cyclonaire is made in four standard sizes with rated capacities of 750, 1650, 3500 and 6000 cfm. Construction can be either 12 ga. steel, lined with Tygon sheet plastic; or fiberglass reinforced polyester. The lined-steel unit comes complete with top mounted blower equipped with a rigid polyvinyl chloride (PVC) rotor. The lighter weight fiberglass reinforced polyester unit utilizes a separately mounted blower duct-connected to the scrubber.

Both units are shipped complete with the necessary packing, either ceramic Intalox saddles, metal or polypropylene Pall Rings, depending on weight factors or corrosive conditions.

40-H

The Cyclonaire is fully described in Bulletin FW-10R, free on request. Write for it today.

PROCESS EQUIPMENT DIVISION

U. S. STONEWARE
AKRON 9, OHIO

[For more information circle #39 on page 37 reply cards]